SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST, 1931.

GENERAL PHYSICS.

2517. Practical Unit of Mass. F. Correggiari. *Elettrotecnica*, 18. *pp*. 151–153, *March* 5, 1931.—The author points out that the practical unit of force is the weight of the kilogramme, and that therefore the practical unit of mass should be the mass for which this force produces an acceleration of 1 m. per sec.^{2}, *i.e.*, a mass of *g* kgm. He therefore proposes that the practical international unit of mass should be 9·81 times as great as the international prototype kilogramme at Sèvres. He proposes, further, that this practical unit should be termed the Gal, in honour of Galileo. He points out that the objection based on the fact that *g* varies with the latitude applies equally to the present practical unit of force.
J. W. T. W.

2518. Density Determination of Solid Substances, Especially Inorganic Salts. P. Wulff and A. Heigl. *Zeits. f. phys. Chem.* 153. *Abt. A*. 3–4. *pp*. 187–209, *March*, 1931.—It is shown, using cæsium chloride as an example, that the pyknometer method of determining the density of a solid substance almost always yields too low values. Details are given of an improved suspension method, and, for salts which, in consequence of their high specific gravities, cannot be determined in this way the buoyancy method is shown to give results which are accurate within 1 ‰.
H. H. Ho.

2519. Precise Measurement of Time. A. L. Loomis. *Roy. Astron. Soc., M.N.* 91. *pp*. 569–575, *March*, 1931.—Investigations carried out since August, 1928, to study: (1) the most accurate types of pendulum clocks now in existence; (2) other time-keeping devices; (3) developments of methods for the automatic and continuous intercomparison of a group of time-keepers; (4) development of improved time-keepers. In the opinion of the author, the Shortt clock is the most accurate time-keeper for periods longer than a day, and the Bell telephone crystal oscillator for periods of one day and less. In the latter a change of 1 part in 10^{10} can be detected over a period of 10 sec. Three Shortt clocks (at Tuxedo) are compared by means of the Loomis chronograph with one another and with a Bell telephone oscillator, the frequency of the latter being led over a private wire from New York. Details of the Loomis chronograph, with two photographs, are given. The mountings of the Shortt clocks to give freedom from changes of temperature, pressure and so forth are described. H. M. B.

2520. Analysis of Records Made on the Loomis Chronograph by Three Shortt Clocks and a Crystal Oscillator. E. W. Brown and D. Brouwer. *Roy. Astron. Soc., M.N.* 91. *pp*. 575–591, *March*, 1931.—Material analysed consists of records from the clocks and oscillator from September 7, 1929, to January 31, 1930. For the first 54 days every record is read and averaged into hourly means. For the whole period the intersections of the line of perforations on the chronograph with those giving the hours are read. The differences between each clock and the oscillator are obtained, examined and plotted against the hours of the day. The analysis is carried out to find any periodic changes and to interpret them. Very little error is found due to the coupling of the clocks and oscillator to the chronograph. A semi-diurnal lunar effect is recorded and theoretically verified. A 10·5 day oscillation is thought to be due to some vibration between the piers on which the pendulums are bolted.

H. M. B.

2521. Spherometers. A. Biot. *Ann. Soc. Sci. de Bruxelles,* 51. *pp.* 5–12, *March* 12, 1931.—Description of a spherometer employing the compass principle. Classification of spherometers according to the geometrical formula on which they are based. G. C. McV.

2522. Mercury-Vapour Ejector. P. Ansiau. *Comptes Rendus,* 192. *pp.* 670–671, *March* 16, 1931.—A pump has been constructed in pyrex glass, with a boiler for the mercury the vapour of which works the ejector. The glass jet through which the mercury vapour flows out passes through a cylindrical glass tube, which tapers down to a small opening. This is cooled outside by water to condense the mercury vapour which escapes from the jet, preventing it from penetrating into the high vacuum formed in the upper part of the cylindrical tube. The condensed mercury flows back to the boiler. Care has to be taken to use the correct dimensions and angles for the conical parts of the apparatus. A water-jet pump is used to obtain the primary vacuum in the lower part of the cylindrical tube. Without a mercury trap there is difficulty in measuring the final vacuum with a MacLeod gauge, using a primary vacuum of 25 to 35 mm. With a trap no kathodic phenomena are obtained with 60 to 70 kV at 50 ∼ between the points of a discharge. H. N. A.

2523. Recent Apparatus for Tracing Curves. S. Jellinek. *Zeits. f. Instrumentenk.* 51. *pp.* 187–197, *April,* 1931.—For a number of recently patented forms of apparatus, by which ellipses, parabolæ, hyperbolæ and other conic sections may be traced, details of the construction and principles of action are explained and illustrated by diagrams. R. S. R.

2524. Viscometer with Constant Velocity of Flow. W. Herold and K. L. Wolf. *Zeits. f. phys. Chem.* 154. *Abt. A.* 1–2. *pp.* 183–186, *April,* 1931.—Two figures show the essential parts of the viscometer, which is such that the velocity of the liquid in the capillary tube remains constant during the experiment. By means of taps the pressure can be quickly adjusted to bring the liquid to any desired level, and, moreover, the tube can be easily emptied and cleaned. The results obtained with it show a greater accuracy than those obtained by the Thorpe-Rodger apparatus.

H. M. B.

2525. Viscosity of Emulsions. Part II. J. O. Sibree. *Faraday Soc., Trans.* 27. *pp.* 161–176, *April,* 1931.—Previous work [see Abstract 2063 (1930)] is continued. The viscosities of emulsions of viscous and limpid paraffin were determined, and from the results the particle sizes were deduced. The viscosities of both coarse and fine emulsions were measured. An apparatus was designed for removing the air from the emulsions, by means of which the emulsion was run in a thin stream into a moderate vacuum. The results confirmed Hatschek's deduction that the viscosities of emulsions having the same continuous phase and different disperse phases were independent of the viscosity of the latter. F. J. B.

2526. Mechanism of Plastic Flow. G. E. Cunningham. *J. Phys. Chem.* 35. *pp.* 796–814, *March*, 1931.—When a clay suspension is centrifuged the relationship between the amount of water retained W and the pressure P exerted on the gelatinous material is curvilinear, whilst that between P and dW/dP conforms to the theoretical probability curve. The free liquid formed in a viscosimeter as a result of pressure on the gel is retained between the particles and acts as a lubricant or forms a more dilute gel. The mobility of clay pastes, as a function of the external pressure, has been investigated. With thick pastes the mobility falls to a minimum with increasing pressure, then rises considerably to a maximum, and finally diminishes; at any given pressure the change of mobility is equal to the difference between the increase resulting from the increase of the quantity of free water, produced at the expense of adsorbed water, and the decrease caused by increase of internal friction. Both factors diminish as the water content of the paste is increased. This view is in accordance with existing data on capillary flow. It is suggested that plasticity is due to the ability of a material to undergo a change of mobility, as a result of applied pressure, which is entirely independent of the shearing force. H. F. G.

2527. New Method of Determining Surface Tension. H. Mache. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 9–10. *pp.* 659–665, 1930.—The apparatus consists of a capillary tube with a small glass bulb on the lower end. The upper end opens under the liquid of which the surface tension is required. As the pressure above the liquid is lowered, air rises out of the capillary tube and the meniscus becomes hemispherical. At this point the radius of the air bubble suddenly changes until it is considerably larger without any further lowering of the external pressure. A theory is given. The instability of the bubble does not occur exactly at the point when it is hemispherical, but so near that, considering this as correct, the surface tension may be measured with an accuracy of 1 %. H. M. B.

2528. Surface Tension of Mercury. Marie Kernaghan. *Phys. Rev.* 37. *pp.* 990–997, *April* 15, 1931.—Consistent values for the surface tension of mercury in a high vacuum (air pressure less than $1\cdot 2 \times 10^{-5}$ mm. Hg throughout the period of experimentation), ranging from $438\cdot 4 \pm 0\cdot 3$ dynes per cm. at $12\cdot 5°$ C. to $429\cdot 9 \pm 0\cdot 6$ dynes per cm. at 67° C., have been found by a modified flat-drop method. In evaluating them Worthington's equation $\sigma = \frac{1}{2}(K - k)^2\rho[1\cdot 641L/1\cdot 641L + (K - k)]$ was used. The temperature gradient, determined from the best mean straight line through the experimental points, is $0\cdot 3015$ dyne per cm. per degree. Hence the average value of k, in the Eötvös relation, was found to be $1\cdot 82$. Reproduction of concordant results at intervals during a period of four months affords ample evidence of the thorough outgassing of the apparatus and is attributed to the great care used in securing relative perfection of details. AUTHOR.

2529. Molecular Theory of Surface Energy. R. S. Bradley. *Phil. Mag.* 11. *pp.* 846–849, *April*, 1931.—By consideration of the cohesive forces operative between two masses of liquid an expression has been derived for the surface energy of a pure liquid; the calculated values are in good agreement with those observed experimentally. H. F. G.

2530. Deduction of the Logarithmic Mixture Law from General Principles. K. Lichtenecker and K. Rother. *Phys. Zeits.* 32. *pp.* 255–260, *March* 15, 1931.—It is shown that the following four postulates restrict the possible laws connecting the property x of a mixture with those (x_1 and x_2) of its components, when the fraction by volume of the first component is v_1. Among these laws, one of the simplest is the logarithmic. The postulates are: (1) that the property x is independent of the way in which the mixture has reached its state; (2) that if x_1 and x_2 are both increased n-fold, then x is increased in the same ratio; (3) that x is the same whether calculated from v_1, x_1 and x_2 or whether the components of the mixture are regarded as two other mixtures of different compositions v_1' and v_1'' with the values x_1', x_2' corresponding; (4) that the volumes are additive. J. H. A.

2531. Contraction of Liquids on Mixing. N. Gerasimov. *Phys. Zeits.* 32. *pp.* 226–229, *March* 1, 1931.—The mixing of two liquids is regarded as analogous to that of two kinds of shot of different sizes, and is considered mathematically on this basis. The results thus obtained seem to accord with experimental results. T. H. P.

2532. Anomalous Flow of a Strong Solution of Lithium Chloride through Narrow Glass Tubes. G. W. S. Blair and R. K. Schofield. *Phil. Mag.* 11. *pp.* 890–896, *April*, 1931.—The flow characteristics of concentrated (10·9 N) solutions of lithium chloride exhibit two marked anomalies: the rate of flow-pressure difference curve, although linear, makes a small intercept on the pressure axis; small strains are thus not dissipated immediately during the flow, possibly as a result of the persistent tendency of the ions to maintain a non-random distribution. Further, the flow does not conform exactly to the simple R^4 law (R = tube radius), and this type of discrepancy, the cause of which is obscure, is therefore not confined to suspensions. H. F. G.

2533. Circulatory Currents and Dead Water. U. Cisotti. *Accad. Lincei, Atti*, 13. *pp.* 85–92, *Jan.* 18, *and pp.* 247–253, *Feb.* 15, 1931.—Mathematical. Conformal correspondence between a circular and a semi-circular field; vortex within the semi-circle; local circulatory currents in relation to a dead-water region bounded by a flexible boundary; the same for a dead-water region whose boundary is part rigid, part flexible; electrostatic interpretation of results. The dead-water region with boundary part rigid and polygonal (including the case of one straight line), part flexible. A. D.

2534. Turbulence Circulation in Flowing Incompressible Fluids. H. Ertel. *Gerlands Beitr. z. Geophys.* 29. 3–4. *pp.* 339–343, 1931.—If turbulence flow be considered as the superposition of a stationary laminar motion ($\bar{v}$) and of a non-stationary additional turbulence current (v'), then $v = \bar{v} + v'$, and, under certain suppositions, the variation of the turbulent circulation, $d/dt\oint v_s' ds$, is zero or only determined by the mean virtual friction, and is therefore independent of the components of turbulent velocity existing in the moment of change. H. H. Ho.

2535. Flow of Liquids in Pipes of Circular and Annular Cross-Sections. A. P. Kratz, H. J. Macintire and R. E. Gould. *Univ. of Illinois Bull. No.* 222. [26 *pp.*], *March* 17, 1931.—The flow of water and of solutions of calcium chloride (max. spec. gr. 1·157) in circular pipes of respective diameters 1¼ in. and 2 in., in elbows, and in annular channels of internal diameter about 0·17 ft. and of external diameter ranging from 0·0883 ft. to 0·1383 ft. is investigated. The results show that the Reynolds number can be employed to correlate friction factors over a wide range of conditions, and is independent of the fluid, provided channels of geometrically similar cross-sections are employed. This procedure is not justified when the cross-sections are not geometrically similar; even then friction factors can be correlated with temperature, velocity and viscosity. The Reynolds number is not applicable for correlating pressure losses in elbows but is convenient for purposes of expressing and plotting the data. Loss of pressure head in elbows is largely influenced by eddies and cross-currents, rather than by surface friction. J. S. G. T.

2536. Vibrations of Cylindrical Columns in Water under the Influence of Alternate Vortices. P. Dupin and E. Crausse. *Comptes Rendus,* 192. *pp.* 729–731, *March* 23, 1931.—In addition to the mode of vibration in a stream of water of cylindrical columns, ***perpendicular*** to the direction of flow, discussed in a previous paper [see Abstract 335 (1931)] another mode, ***parallel*** to the velocity of the stream, is possible. This latter mode of vibration is here briefly discussed experimentally. Experiments with brass cylinders indicate that the vibration was scarcely perceptible with cylinders of diameters less than about 4 mm., but was very marked with cylinders of diameter 8–10 mm. J. S. G. T.

2537. Plane Motion of Viscous Liquids in the Region of Radial Motion. A. Rosenblatt. *Comptes Rendus,* 192. *pp.* 920–922, *April* 20, 1931.—The author discusses mathematically certain aspects of motion accompanying the radial motion of incompressible viscous fluids discovered by Hamel. J. S. G. T.

2538. Behaviour of Two Vortices. S. Fujiwhara. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 106–110, *March,* 1931.—The motion of two vortices in a liquid is investigated photographically, and it is clearly shown that there is a tendency for two vortices with the same sense of rotation to approach and for those with opposite senses to separate. [See also Abstract 2374 (1923).] AUTHOR.

2539. Alternate Bénard-Kármán Vortices and Reynolds' Law of Dynamic Similitude. P. Dupin and Teissié-Solier. *Comptes Rendus,* 192. *pp.* 1017–1020, *April* 27, 1931.—Reynolds' law is shown experimentally to apply to the alternate free vortices formed in the wake of circular cylinders of diameter 4–12 mm., placed either in water or in a solution of ammonium oleate. The study of vortices in the wake of obstacles of other than circular section led to the following conclusions: (1) the periods of formation of alternate vortices in the wake of prismatic obstacles of similar cross-section satisfy Reynolds' law, and (2) the length of the obstacle in the direction of flow and its form considerably affect the frequency of the vortices. J. S. G. T.

2540. Vortex Formation behind Obstacles of Various Sections. E. Tyler. *Phil. Mag.* 11. *pp.* 849–890, *April,* 1931.—Various methods of estimating the frequency of vortex formation behind inclined cylinders, aerofoils, and plates in air and water are described. An account is given of differential methods for measuring the longitudinal spacings l of such vortices: two electrically-heated platinum wires are used in conjunction with a vibration galvanometer or valve amplifier, and the method is based upon the fact that the velocity fluctuations at two points without and on the same side of a vortex stream are in phase when the longitudinal distance between the points is equal to the distance (or a multiple thereof) between successive vortices in the same row. Measurements of the lateral spacings h of the vortex rows yield values of h/l which accord well with theory, but the extreme variations among the results indicate that a basic velocity gradient may exist. For inclined plates and aerofoils $Nb \sin \theta/V$ is constant between 20° and 90°, whilst the longitudinal spacings yield constant values of $l/b \sin \theta$ between 30° and 90°. A linear relationship governing the tendency of l to increase downstream has been established. H. F. G.

2541. Forces on a Solid Moving Through a Viscous Fluid. S. Goldstein. *Roy. Soc., Proc.* 131. *pp.* 198–208, *April*, 1931.—In a previous paper [see Abstract 2075 (1929)] a general theorem was stated concerning the resultant force on a solid body of any size and shape moving with uniform velocity through otherwise still fluid of given density. The equations then derived gave a solution only when the solid body is of revolution and so were not sufficiently general, a defect remedied by the present entirely mathematical paper. Remarks by **J. M. Burgers** are included in the text. H. H. Ho.

2542. High-Speed Wind Channel for Research in External Ballistics. T. E. Stanton. *Roy. Soc., Proc.* 131. *pp.* 122–132, *April*, 1931.—By the use of a compressor capable of compressing 200 cub. ft. of air per min. at a pressure of 120 lbs. per sq. in., the air expanding through a converging-diverging nozzle, terminating in a parallel portion, to a pressure about 1/10 its original value, it was found possible to maintain continuously on the parallel part, of diameter 0·8 in., an air current moving at about twice the speed of sound. The design of the nozzle for sensibly adiabatic expansion of the air is briefly referred to. The design of a channel of diameter 3·07 in., in which speeds up to 3¼ times that of sound can be maintained continuously, is also described. Results obtained in this latter channel and referring to different methods of reducing head resistance by stream lining the head are briefly discussed. J. S. G. T.

2543. Compressibility and Pressure Coefficient of Resistance, Including Single-Crystal Magnesium. P. W. Bridgman. *Am. Acad., Proc.* 66. *pp.* 255–271, *March*, 1931.—Ten new materials have been investigated for compressibility, all of which except Mg have cubic crystals, so that it is not necessary to use single crystals. Mg has hexagonal crystals, so single crystals were used, and the compressibility was measured parallel and perpendicular to the axis, and the specific resistance in the same directions determined. The compressibility of AlSb is less than the mean between those of the pure metals, weighted according to their atomic volumes. It is probable that part of the difference is due to internal cohesive pressure. The compressibility of CdTe and HgTe differs even more from the value calculated from the rule of mixtures. TiN and TiC have very low compressibilities; their electrical resistance puts them in the metallic class. This is also confirmed by the effect of pressure on resistance. In Mg the axial ratio corresponds to a piling of spheres in close-packed hexagonal array. The compressibility in different directions would be expected to be the same, and this proves to be nearly the case. The specific resistance in different directions differs more than is to be expected on this consideration. Interesting facts with regard to the compressibilities of NaF and CdF_2 are mentioned. For previous work see Abstract 1724 (1930). H. N. A.

2544. Dilatancy and the Pressure Exerted by Granular Material. C. F. Jenkin. *Roy. Soc., Proc.* 131. *pp.* 53–89, *April*, 1931.—Dilatancy explains the impossibility of securing reproducible results in attempts to determine the coefficient of friction of sand, and the upheaval caused by revolving a circular horizontal plate therein at some distance below the surface. Experiments with a large number of steel discs, 1 in. dia. and ¼ in. thick, piled on one another with circular edges touching, supported by one fixed and one movable " wall " and standing on a movable base, show that any small change in position of a movable boundary results in a series of gaps or slack contacts, which are definite limits to the lines of action of the forces. Solutions are given for slack contacts along horizontal and diagonal lines, corresponding respectively to " ordinary pressure " and " arching." Investigation of the action of sand by means of a movable vertical " wall," 21 in. by 3 in., with arrangements for determining the pressure of the sand thereon, show that the direction of pressure is inclined to the normal at the angle of friction; the position of the centre of pressure is indeterminate, and may be much above one-third the height of the wall; and the pattern of the packing and grain shape are of fundamental importance. Ordinary and arched loosest packings give definitely different pressures. C. A. S.

2545. Perturbations Produced by Many Rigid Spheres in an Elastic Medium in Equilibrium. E. Volterra. *Accad. Lincei, Atti*, 13. *pp.* 32–37, *Jan.* 4, 1931.—Continues previous work [see Abstract 3322 (1930)] and draws close analogies to electrostatic problems and deals with the influence of one sphere and also that of many. A. D.

2546. Elasticity, Thermal Agitation and Fusion of Solids. L. Brillouin. *Comptes Rendus*, 192. *pp.* 668–669, *March* 16, 1931.—In a previous paper thé author [see Abstract 694 (1926)] has given an expression for the density of the potential energy of a solid at rest, without thermal agitation or external pressure, when it is slightly deformed. This is in terms of the two coefficients of Lamé, λ and μ, and three invariants I_1, I_2, I_3 of degree 1, 2 and 3, depending on the deformations. λ and μ are equal to one another according to the theory of central forces between the atoms. There are also three coefficients A, B and C in the expression. The author now supposes that a small dilation takes place, due to the pressure p' of the waves of thermal agitation; and shows that this pressure does work, $p'\delta v$, if the cubical dilation is $\delta v/v$, so that an additional term $p'\delta v/v$ must be added to the density of the energy. This is given in terms of new invariants, J_1, J_2, J_3. The result is that the values of the Lamé coefficients are altered to $\lambda_1 = \lambda' + p'$ and $\mu_1 = \mu' - p'$, so that $\lambda_1 - \mu_1 = 2p'$. If the temperature is raised sufficiently, μ_1 diminishes to zero and the solid fuses; it is unable to resist a shear. H. N. A.

2547. Elasticity, Temperature and Melting Point. W. Widder. *Phys. Zeits.* 32. *pp.* 349–351, *April* 15, 1931.—The author's previously suggested relation between Young's modulus, temperature and melting point [see Abstract 219 (1926)] is revised to satisfy the new experimental data of Koch and Dieterle, Andrews, and Dodge. Values of the constants A and B in the new relation $E = A \, . \, e^{-B/\tau - t}$, are found, where E is Young's modulus at t° C., and τ° C. is the melting point. Agreement with experimental results is found to be satisfactory for Fe, Ni. Al, Au, Pb, Ag and Pt. J. P. A.

2548. Representation of Magnitude and Direction of Internal Stresses in Problems of Plane Elasticity. Tesar. *Comptes Rendus*, 192. *pp.* 728–729, *March* 25, 1931.—The representation of the internal stresses characterising equilibrium in the case of plane elastic problems by two systems of orthogonal curves, termed respectively the isostatic and dynamic-isostatic system, is briefly discussed. **Errata**, *ibid.* p. 1064, April 27, 1931. J. S. G. T.

2549. Relations between the Strengths of Various Metals under Alternating Flexural and Torsional Loads. R. Scheu. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 9–10. *pp.* 535–544, 1930.—The strengths under long-continued alternating flexural and torsional loads are found for a number of metals. The ratio of strength under torsion to strength under flexure is always 0·575. If these two strengths are reduced to the fractions β, α of their former values when a notch is made on the polished surface of the test-piece, then $(1 - \beta)/(1 - \alpha)$ is also 0·575. The same number has also occurred as the ratio of the limiting stresses for producing flow in static torsional and tensile tests. The only exceptions found were samples of cast iron, in which graphite inclusions appeared to produce internal weakening. J. P. A.

2550. Torsion Problem for Circular Shafts of Varying Radius. A. Thom and J. Orr. *Roy. Soc., Proc.* 131. *pp.* 30–37, *April*, 1931.—An equation already obtained by Love for the stresses and strains in a circular shaft can be solved directly for certain boundaries; but up to the present, for the general case, it has been solved only by approximate graphical methods. A solution is here developed by a method of arithmetical trial and error, which may be carried to any degree of accuracy. An example is given in illustration. The Appendix contains other problems which can be dealt with by similar methods, *e.g.*, torsion of a prism of non-circular section, perfect and viscous fluid flow. H. M. B.

2551. Vibration of U Bars. G. H. Keulegan. *Bureau of Standards, J. of Research*, 6. *pp.* 553–592, *April*, 1931.—A full theoretical analysis is made of the problem of the vibration of U bars composed of a semicircular yoke and straight prongs. Rayleigh's method and Ritz's approximation for initially curved bars are used considerably. To facilitate comparison with static experiments, the paper shows how to calculate the position of a static load, so that displacements of points along the bar shall be very nearly in the same proportions as when the bar vibrates in its fundamental mode. J. P. A.

2552. Stresses in a Stretched Plate Containing a Circular Insertion. K. Sezawa and G. Nishimura. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 68. *pp.* 25–43, *April*, 1931. *In English.*—A large elastic plate subject to a longitudinal tension has a circular hole in which is cemented a plug of a different material. The stress distribution in and around the insertion is worked out mathematically, and the results are summarised in diagrams. In all cases the stresses in the plug are constant along a radius, but are different along different radii. Discontinuities in the stresses occur at the boundary of the plug, the higher stresses always being found in the material of greater elasticity. If the tension is applied in the direction $\theta = 0$, the greatest discontinuity is exhibited by the tangential stress at $\theta = \pm \pi/2$. J. P. A.

2553. Buckling of a Rectangular Plate Clamped at Four Edges. K. Sezawa. *Tokyo Univ. Aeronaut. Research Inst. Report No.* 69. *pp.* 45–59, *April*, 1931. *In English.*—An approximate solution of the problem of the buckling of a rectangular plate clamped along all four edges is secured by allowing the slope at the edges to differ from zero except at the mid-points of each edge. The condition for the buckling of a plate whose length is double its width differs very little from the condition for an infinitely long plate. J. P. A.

2554. Non-holonomous Systems with Bonds Depending on the Time. G. Vranceanu. *Accad. Lincei, Atti*, 13. *pp.* 38–44, *Jan.* 4, 1931.—In a previous paper [see Abstract 867 (1927)] the author showed how to arrive at an expressive form for the equations of motion of a material non-holonomous system with bonds independent of the time, if use be made of the geometrical conception of non-holonomous variety. He now does the same thing for non-holonomous systems with bonds depending on the time, and obtains results analogous to the ordinary results for holonomous systems. A. D.

2555. Reaction Forces. E. Gugino. *Accad. Lincei, Atti*, 13. *pp.* 269–274, *Feb.* 15, 1931.—The reaction forces are guided by the applied forces into various types, static and kinetic respectively. For previous work see Abstracts 713 and 1450 (1931). A. D.

2556. Dynamical Systems with Slow Variation. Y. Hagihara. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 44–47, *Feb.*, 1931. *In English.*—In the solution of a dynamical system by means of semi-convergent series, the author determines the time-interval over which such an approximation can be said to hold, to a given degree of accuracy. G. C. McV.

2557. Mixed Inverse Problem and Sliding Surfaces in Doubly-Connected Space. B. Demtchenko. *Comptes Rendus*, 191. *pp.* 604–606, *March* 9, 1931.—Let the boundaries Σ_i and Σ_e of a doubly connected region Ω (plane Z) be composed of several arcs ω_σ and $\lambda_\sigma(\sigma = 1, 2, \ldots, n)$ and let the values g which the harmonic function ψ takes at boundaries Σ_i and Σ_e, its normal differential $d\psi/d\mathrm{N} = h_\sigma$ upon the arcs λ_σ, and the parts ω_σ of the boundary be also known, then the mixed inverse problem considered in the paper consists in the investigation of the arcs λ_σ and of the harmonic function ψ according to the above data [see Abstract 2999 (1930)]. H. H. Ho.

2558. Polymerisation in the Crystal Lattice. Crystal Structure of Trinitroresorcin and Trinitrophloroglucin. E. Hertel and K. Schneider. *Zeits. f. phys. Chem.* 12. *Abt. B.* 3. *pp.* 139–150, *March*, 1931.—Both compounds belong to the triclinic system, and the elementary cells are commensurable. It is noteworthy that, although the structures are so similar, a continuous series of mixed crystals is not found: only a eutectic appears in the phase diagram. F. I. G. R.

2559. Equilibrium Curves of Filaments of which the Elementary Parts are Subjected to Central Forces. E. Baticle. *Comptes Rendus*, 192. *pp.* 1016–1017, *April* 27, 1931.—The problem discussed is to find the law of central forces corresponding to a given funicular curve. The solution is effected by constructing the Cremona polygon corresponding to the isostatic system composed of the elements of the funicular curve and the *radii vectores* drawn from the centre of force. J. S. G. T.

2560. Crystal Orientation of Electrodeposited Layers. W. A. Wood. *Phys. Soc., Proc.* 43. *pp.* 138–141; *Disc.*, 141, *March* 1, 1931.—The influence of the crystal orientation of a kathode on that of an electrodeposited layer is studied by X-ray methods for the cases of copper and nickel, respectively, deposited on rolled copper. The conditions of kathode surface and current density which accompany an oriented deposit are determined. The orientation of the copper deposit for small currents is the same as that of the kathode. The nickel, at low current densities, assumes a distinct orientation. As the current is increased there is a region of no orientation, followed, at still higher currents, by an orientation the same as that of the kathode surface below. AUTHOR.

2561. Structure of Plastic Sulphur. J. J. Trillat and J. Forestier. *Comptes Rendus*, 192. *pp.* 559–561, *March* 2, 1931.—A thread of plastic sulphur, when drawn out rapidly immediately after formation, can be extended to 8 to 10 times its initial length. Such an extended thread has a breaking strength of 9 to 10 kg./mm.^{2}, as compared with 70 gm./mm.^{2} for the ordinary plastic material. It is flexible at first, but becomes brittle after a few days. X-ray examination shows that the sulphur is not amorphous, but possesses a structure analogous to that of metal wire or cellulose thread with $a=9\cdot35$ Å., as compared with $a=10\cdot61$, $b=12\cdot87$, $c=24\cdot56$ Å., the dimensions of the unit cell of rhombic sulphur, into which form it passes after a few days. The same change in ordinary plastic sulphur is greatly accelerated by exposure to X-rays. C. A. S.

2562. Crystal Structure of Di-Pentaboron-Heptahydride, $B_{10}H_{14}$. H. Möller. *Zeits. f. Krist.* 76. *pp.* 500–516, *March*, 1931.—Goniometric observations, together with the evidence of etch-pits, indicate the structure to be rhombic-bipyramidal, with the axial ratios, $a : b : c = 0\cdot6935 : 1 : 0\cdot2728$. Layer-line photographs give the following data for the edges of the elementary parallelepiped, $a = 14\cdot46$ Å.; $b = 20\cdot85$ Å.; $c = 5\cdot69$ Å. The space group is V_h^{21}. It would appear that in chain structures, the chains cannot be straight, but must be bent. A double-ring structure, similar to that of naphthalene, is suggested. F. I. G. R.

2563. Stannichlorides and Stannibromides of Toluidines and Substituted Anilines. P. Maier. *Zeits. f. Krist.* 76. *pp.* 529–541, *March*, 1931.—Crystallographic data and densities are given, but no generalisations arising from the results could be obtained. C. A. S.

2564. Nomenclature of Space Groups. C. Mauguin. *Zeits. f. Krist.* 76. *pp.* 542–561, *March*, 1931. *In French.*—A complete system of nomenclature, based on C. Hermann's system [see Abstract 2657 (1929)] as modified by the author's own proposals, is given for the 32 point groups, the 75 chain groups, the 80 net groups, and the 230 space groups, together with Alexander's notation for the chain groups [see Abstract 2925 (1929)], and Schoenflies' notation for the space groups. A table giving the last with the notation adopted by the International Conference at Zurich is also added, this notation being very similar to that of the author. A note added by **C. Hermann** shows the chief differences from his system, and suggests that for a time results should be published in both systems, the new and the Schoenflies. C. A. S.

2565. Structure of Solid H_2S and H_2Se. L. Vegard. *Zeits. f. Krist.* 77. 1–2. *pp.* 23–35, *April*, 1931.—In a specially designed spectrometer the gases were condensed on a metal rod cooled to the temperature of liquid air, and X-ray powder photographs were then taken. It was deduced that both substances are cubic with a cube edge of 5·79 Å. for H_2S (density 1·16) and 6·05 Å. for H_2Se (density 2·39). The S and Se atoms lie on a simple face-centred lattice, and the positions of the hydrogen atoms are discussed in considerable detail. On the assumption of a co-ordination lattice of the fluorspar type, interatomic distances deduced are $S - H = 2{\cdot}51$ Å., $Se - H = 2{\cdot}62$ Å. and the radius of the hydrogen atom 0·77 Å. in H_2S and 0·71 Å. in H_2Se. W. H. Ge.

2566. X-Ray Study of Iron Tetracarbonyl. R. Brill. *Zeits. f. Krist.* 77. 1–2. *pp.* 36–42, *April*, 1931.—From goniometric measurements and X-ray single crystal rotation photographs it is deduced that iron tetracarbonyl crystallises in the monoclinic space group C_{2h}^{6} having the constants $a = 13{\cdot}00$, $b = c = 11{\cdot}41$ Å., $\beta = 85° \ 35'$, $a : b : c = 1{\cdot}137 : 1 : 1$. In the crystal, as also in solution, the molecule polymerises to $[Fe(CO_4)]_3$, and the molecule is probably arranged as $(CO)_4Fe(CO)_2Fe(CO)_2Fe(CO)_4$. W. H. Ge.

2567. Crystal Structure of Anhydrous Sodium Sulphate. M. Y. Colby. *Zeits. f. Krist.* 77. 1–2. *pp.* 49–60, *April*, 1931. *In English.*—The temperature-solubility curve shows a minimum at about 70° with respect to variation, and thus by keeping a concentrated solution within a degree or so of this temperature, extremely well-developed crystals were obtained. The anhydrous salt is orthorhombic holohedral with the axial ratios: $a : b : c = 0{\cdot}4731 : 1 : 0{\cdot}7996$. X-ray analysis with Laue, rotation and powder photographs show the unit cell to contain eight molecules of Na_2SO_4, and to have the following dimensions: $a = 5{\cdot}812$ Å., $b = 12{\cdot}30$ Å., $c = 9{\cdot}82$ Å. The sulphate tetrahedron has the distance $S - O = 1{\cdot}5$ Å., which is almost the same as the double-sulphate figure (Li, K) and (Li, Rb) for the same group, though the crystal system in these two cases is hexagonal. F. I. G. R.

2568. Crystal Structure of Mercuric Bromide. H. J. Verweel and J. M. Bijvoet. *Zeits. f. Krist.* 77. 1–2. *pp.* 122–139, *April*, 1931.—Rhombic mercuric bromide has a basic-centred unit cell with the dimensions $a = 4{\cdot}67$, $b = 6{\cdot}85$ and $c = 12{\cdot}45$ Å., containing four molecules. Only in the space group C_{2v}^{12} can a structure in accord with the observed intensities be determined. The crystals are, therefore, pyramidal and not, as stated in the literature, bipyramidal. T. H. P.

2569. Stereochemistry of Crystalline Compounds. Part V. Lattice-Energetic Foundation for the Distribution of the Crystalline Compounds AB and BAB in the Various Structural Types. P. Niggli. *Zeits. f. Krist.* 77. 1–2. *pp.* 140–145, *April*, 1931.—Recent work on lattice energy shows that, in accordance with the earlier considerations on the stereochemistry of crystalline compounds [see Abstract 1452 (1931)], the structure types AB and BAB are characterised principally by the distance relations d_A, d_B and d_{AB} and by the corresponding coordination numbers, since these, together with the electron distribution in A and B, determine the lattice energy. T. H. P.

2570. Structure of β Alumina. W. L. Bragg, C. Gottfried, and J. West. *Zeits. f. Krist.* 77. 3–4. *pp.* 255–274, *April*, 1931. *In English.*—Alumina Al_2O_3 is apparently tetramorphous (α, β, γ, δ). Of these, α is the well-known corundum, β is the form considered in this paper, γ is cubic, and δ seems to be akin to α, but on an enlarged scale. The presence of sodium is considered to be a condition for the formation of β alumina. The X-ray analysis presents unusual difficulties, but a solution of the problem (which may not be final) is as follows: β alumina is hexagonal with $a = 5{\cdot}56$ Å., and $c = 22{\cdot}55$ Å. Parallel to the basal plane (0001) are sheets of atoms (O, Al), bound together partly by pairs of tetrahedra (O, Al) and partly by Na. The marked cleavage is explained. F. I. G. R.

2571. Systematic Representation of Important Selection Rules Relating to Crystal Structure in the Hexagonal and Rhombohedral Space Systems. E. Schneider. *Zeits. f. Krist.* 77. 3–4. *pp.* 275–316, *April*, 1931.—The title explains the contents, which are presented in tabular form. F. I. G. R.

2572. Problem in the Quantum Mechanics of Crystals. E. L. Hill. *Phys. Rev.* 37. *pp.* 785–794, *April* 1, 1931.—An elementary method is given for treating a one-dimensional lattice of the " tooth-valley " type containing any number of unit cells. The reflection of a beam of electrons from such a lattice is studied. For a semi-infinite lattice perfect reflection is shown to occur when the Bragg equation is satisfied, and an approximate formula for the widths of the reflection bands for high speed electrons is found. For the bound electrons the theory predicts occupied energy levels in the vicinity of the allowed levels for a single valley with infinitely high walls, in agreement with the perturbation theory. A simplified way of locating the edges of the reflection bands is discussed. The more complex case approximating real crystals is considered briefly. AUTHOR.

2573. New Crystallography. F. I. G. Rawlins. *Nature,* 127. *pp.* 632–633, *April* 25, 1931.—An article dealing with modern developments along the following lines: (*a*) The union of ions into crystals, in which Fajans' work on refractivity and consolidation for the alkali halides is discussed; (*b*) crystal thermodynamics, containing an outline of theoretical considerations relating to molecular oscillation and rotation in the solid state; (*c*) crystal spectra, with particular reference to absorption in the visible region. Observations are also recorded relating the spectrum of $KMnO_4$ in the crystal to that of the same salt in aqueous solution and in ethyl acetate. F. I. G. R.

2574. Parachor of Tervalent Iodine. N. V. Sidgwick and E. D. P. Barkworth. *Chem. Soc., J. pp.* 807–809, *March*, 1931.—Sugden has shown [see Abstract 2416 (1927)] that compounds of quinquevalent phosphorus and antimony give anomalous parachor values, which he attributes to the formation of singlet links, although they may equally well be ascribed to the expansion of the valency group. The effect of an increase of valency could be tested by means of compounds containing tervalent iodine such as the dichloroiodides or the esters formed by iodoso-compounds with organic acids. Most of these compounds, however, decompose before melting, or just above their melting points, but iodosobenzene propionate, $C_6H_5I\,(O\,CO\,C_2H_5)_2$, proved capable of measurement in chlorobenzene solution and gave a parachor defect of 17·3 units against the expected 26 based on analogy with phosphorus and antimony. H. H. Ho.

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2575. Allotropy of Liquids. Part I. A. Smits. *Żeits. f. phys. Chem.* 153. *Abt. A.* 3–4. *pp.* 287–298, *March*, 1931.—The author's theory of allotropy applied to liquids in 1912 is now more closely studied by him by experimentally investigating the allotropy of the liquids helium and ethyl ether. J. K.

2576. Arrangement of Protons and Electrons in the Atomic Nucleus. W. M. Latimer. *Am. Chem. Soc., J.* 53. *pp.* 981–990, *March*, 1931.—From a study of the number of protons and electrons in those atomic species whose atomic weights are approximately integral multiples of four, together with data on their abundance, a geometrical representation of the atomic nuclei is given in which the protons and electrons are arranged in a definite space lattice. The nucleus must be held together by the coupling of the proton spins, and the model may be interpreted as the pattern determined by the directions of the spin vectors. In it the angle between any two proton vectors is that formed by lines from two corners of a tetrahedron to its centre, and this, in the new quantum mechanics, is the angle at which the two elementary spin vectors add to give a resultant of two units. The abundance curve for the lighter elements of the series shows maxima for 4, 7, 10, 12 and 14 α-particles which suggests that the α-particles are arranged in a tetrahedral pattern. A continuation of the pattern proposed for the arrangement of 4 α-particles in a tetrahedron to 10 α-particles leads to a point in the lattice about which four protons converge in the same manner as in the α-particle. The entrance of a pair of electrons at this point explains the first pair of extra electrons found in argon 40, and an extension of the principle appears to give a complete explanation of the numbers of extra electrons required in the heavier elements. With the addition of the extra electrons the proposed nuclear structure becomes a diamond-type lattice of electron pairs joined by protons. J. J. S.

2577. Diffraction of Hydrogen Atoms. T. H. Johnson. *Phys. Rev.* 37. *pp.* 847–861, *April* 15, 1931.—Improved technique in the photography of the diffraction patterns produced by the reflection of a beam of hydrogen atoms from a crystal of lithium fluoride has resulted in more complete patterns than those previously described by the author [see Abstract 41 (1931)]. The observed patterns are those expected on the assumptions (1) that the incident beam contains the distribution of wave-lengths derived from the Maxwellian velocity distribution by the use of the de Broglie relation between wave-length and velocity, and (2) that the surface of the crystal constitutes an impenetrable square array of scattering points with the arrangement and spacing of the ions of a single type as known from X-ray measurements. The intensity distributions in the diffraction patterns were measured, and were found to have maxima at positions in good agreement with those expected on the basis of the above assumptions. The relative intensities in the observed orders are discussed in relation to the scattering coefficients of the two types of ions, and in relation to the dependence of the scattering coefficient on azimuth. A secondary spectrum is described arising from a lattice of wide spacing, the lines of which are parallel to the 100 cleaved edges of the crystal face. AUTHOR.

2578. Masses of O^{17}. H. C. Urey. *Phys. Rev.* 37. *pp.* 923–929, *April* 15, 1931.—The rest mass of O^{17} is calculated from the known rest masses of N^{14}, He^4 and H^1 and the masses due to the kinetic energies of

He^4, H^1, and O^{17} as determined by Blackett and Harkins in the transmutation reaction $N^{14} + He^4 \rightarrow O^{17} + H^1$. The only assumptions involved are that the conservation of momentum and of mass-energy holds in these reactions. The masses secured in this way from seven sets of data do not agree within the probable limits of error for the experimental data. It is suggested that this is due either to the formation of O^{17} atoms of different masses and energies in this reaction or to the emission of γ-rays during the collision. The former of these predicts discontinuous energy levels while the latter would probably cause the rest mass of O^{17} as calculated here to vary continuously. The relation of this calculation to the experiments of Bothe and Pose on the ranges of H-particles from boron and aluminium is discussed. AUTHOR.

2579. Existence of Isotopes. G. Fournier. *Comptes Rendus,* 192. *pp.* 940–941, *April* 20, 1931.—Continues the author's treatment of the possible isotopes calling attention to the fact that some recently discovered isotopes have atomic weights which were predicted by him. Others fit in satisfactorily in his scheme. The isotope N^{16}, the existence of which is regarded as doubtful by Naudé, seems to be impossible according to the author's classification. A provisional list is given of probable isotopes, which have not as yet been found experimentally. H. N. A.

2580. Atomic Radiation. B. Finzi. *Accad. Lincei, Atti,* 13. *pp.* 119–124, *Jan.* 18, 1931.—On Einsteinian general relativity principles, the author develops a relativistic theory of atomic radiation under which fall, as particular cases or approximations, the mechanics of Heisenberg, the classical mechanics, and the Einsteinian mechanics of radiation. A. D.

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2581. Mass Absorption Coefficient of the K Shell according to the Dirac Relativistic Theory of the Electron. L. C. Roess. *Phys. Rev.* 37. *pp.* 532–555, *March* 1, 1931.—The model atom considered contains two non-interacting electrons and a fixed nucleus with charge Ze. Z is determined so as to make the lowest energy level agree with the value determined from the K-absorption edge. The relativistic coefficient is from 0 to 40 % smaller than Nishina and Rabi's non-relativistic one, the greatest difference being for heavy elements and short wave-lengths. The difference between theory and experiment is least for the heavy atoms, as expected, since in them the neglected interaction field is small compared with the nuclear field. The variation with wave-length is complicated, but in the range $\frac{1}{2}\lambda_k$ to λ_k it is more nearly linear with λ^3 than the non-relativistic coefficient (λ_k=wave-length of the K-absorption edge). All this shows that the model chosen is approximate, even for the heavy elements. H. N. A.

2582. Symmetric Spherical Oscillator and the Rotational Motion of Homopolar Molecules in Crystals. T. E. Stern. *Roy. Soc., Proc.* 130. *pp.* 551–557, *March* 3, 1931.—Definite information is sought about the statistical weights of the lowest quantum states of molecules in crystals. The problem is capable of exact treatment by means of wave mechanics, without the use of perturbation methods. The equation $(1 - x^2)F'' - 2xF' + (\mu + \lambda^2x^2 - m^2)/(1 - x^2)F = 0$, which can be derived from the wave equation for a homopolar molecule of type X_2, free to rotate in a field of axial symmetry, has been considered by A. H. Wilson, among others. Corresponding to any value of λ there exist certain eigenvalues of μ for which the necessary conditions will be fulfilled.

The author has calculated values of μ for the first seven eigenstates of the spherical oscillator, for integral values of λ up to and including six. The resulting curves for λ, μ are numbered by the use of n and m, the quantum numbers of the spatial rotator from which they originate for small λ. From this diagram a large amount of information is drawn as regards the real quantum numbers N and M, of the symmetric spherical oscillator. The criteria for " rotation " and oscillation of the molecules can be derived from the author's results; they are exactly equivalent to Pauling's, but can be derived more simply than his, and are in a simpler form. H. N. A.

2583. Examples of the Uncertainty Principle. C. G. Darwin. *Roy. Soc., Proc.* 130. *pp.* 632–639, *March* 3, 1931.—In the general synthesis of classical dynamics with the quantum theory, the Uncertainty Principle plays a most useful part [see Abstract 38 (1928)], since by its means it becomes easy to see where the old classical ideas broke down. The present paper deals with the subject in connection with electrometers and magnetometers, and should be consulted in its entirety. H. H. Ho.

2584. Measure of Motion. P. Drumaux. *Ann. Soc. Sci. de Bruxelles*, 51. *pp.* 17–19. *March* 12, 1931.—In a previous paper on the nature of Planck's constant [see Abstract 4064 (1930)] the author derived the result that the measure of physical motion finds its expression in terms of frequency. The author here seeks to confirm this result and to meet the objection that it is speed and not frequency that serves as a measure of motion. The argument is based on the change of the de Broglie wavelength of a particle in passing from one system of coordinates to another in relative motion to the first. H. L. B.

2585. Quantum Mechanics of Collisions of the Second Kind. L. Goldstein. *Comptes Rendus*, 192. *pp.* 732–734, *March* 23, 1931.—The energy transfer involved in the collision of an electron with a stationary atom is discussed along the lines of Dirac's quantum mechanics. The theoretical results are comparable in magnitude with the experimental results obtained by Latyscheff and Leipunsky [see Abstract 851 (1931)]. J. S. G. T.

2586. Quantum Mechanics of Atomic Collisions. L. Goldstein. *Comptes Rendus*, 192. *pp.* 1022–1024, *April* 27, 1931.—The calculation is briefly discussed, employing quantum mechanics, of the probabilities of the excitation of discrete or continuous atomic levels by collisions between neutral atoms or fast-moving positive ions. J. S. G. T.

2587. Interpretation of the Density Matrix in the Many-Electron Problem. P. A. M. Dirac. *Cambridge Phil. Soc., Proc.* 27. *pp.* 240–243, *April*, 1931.—It is shown that the probability of one electron being in a given state and a second electron being in some other state, can be expressed as a determinant formed from appropriate elements of the density matrix. The two electrons are, of course, in the same atom. The result is extended to the case of a number of the electrons in the atom being simultaneously each in a given state. The theory shows that, in the scattering of X-rays by atoms or molecules, the amount scattered by one electron should be affected by the presence of the other electrons in the atom, but the effect will be small. G. C. McV.

2588. Mechanics of the Material Particle in the General Theory of Relativity. M. Mathisson. *Zeits. f. Physik*, 67. 11–12. *pp.* 826–844, *Feb.* 25, 1931.—The fundamental equations relating to the field of a charged material particle are derived from the equations of Einstein's gravitational theory. Amongst subjects discussed are the unique characters of the potentials and the constancy of mass and charge. The possibility of linearising the equations, on the basis of Euclidean geometry, is discussed. The necessary calculus is developed in the paper. J. S. G. T.

2589. Electromagnetic Phenomena in a Uniform Gravitational Field. D. Meksyn. *Roy. Soc. Edinburgh, Proc.* 51. *pp.* 71–79, 1930–1931.—Use is made of the metric of a field which contains only a gravitational force, discovered by Whittaker [see Abstract 3067 (1928)], to calculate Larmor's value, $\frac{2}{3}\frac{e^2g^2}{c^3}$, for the rate of radiation of an electron moving freely. This arises from the fact that the field can be transformed into a Euclidean field, hence the electromagnetic potential of the electron in the field can be found by a transformation, the Euclidean value for the problem being given. Poynting's vector is then calculated and its divergence taken throughout the whole of the field of the uniform gravitational force. This yields the result. G. C. McV.

2590. Development of Space Potentials according to Spherical Functions. K. Jung. *Gerlands Beitr. z. Geophys.* 29. 3–4. *pp.* 346–351, 1931.—The development of space potentials according to spherical functions holds in the external space surrounding the whole mass considered and in certain cases over a considerable area inside this containing sphere. It is shown that in the case of an oblate rotating ellipsoid the development of spherical functions should not be employed with respect to the interior of the mass and also not near its outer surface, and not if the series of external space potentials in a part of the mass converges. R. S. R.

2591. Physical Interpretation of the Riemannian Tensor and Principal Curvatures of Class V_3. T. Boggio. *Comptes Rendus,* 192. *pp.* 611–612, *March* 9, 1931.—The author shows that the property of continuous media, established by means of a relatively complicated analysis by Tonolo in a previous paper [see Abstract 3050 (1930)], can be readily established by the use of well-known formulæ. J. S. G. T.

2592. Dynamics of Bodies of Variable Mass. H. Mineur. *Comptes Rendus,* 192. *pp.* 663–666, *March* 16, 1931.—Einstein's law of gravitation applied to determine the field of a star whose mass varies with the time owing to the loss of energy due to radiation. It is shown that the theory gives a relation between the period and eccentricity of the orbit of a particle in the field obtained similar to that observed in the case of double stars. The numerical values, however, show that the loss of mass should be 10^3 times the observed value. G. C. McV.

2593. End of the World from the Standpoint of Mathematical Physics. A. S. Eddington. *Nature,* 127. *pp.* 447–453, *March* 21, 1931. *Supplement. Presidential Address to the Mathematical Assoc.*—The lecture is concerned with the properties of time. In the physical world, the only counterpart to the going on of time in consciousness is found in the continual increase of entropy. The "end" of the universe is therefore conceived as the condition of maximum entropy in which all matter has probably turned into radiation at a uniform temperature, and occupies a spherical universe of rapidly expanding radius. The "beginning" of the world presents a feature of greater interest in that it corresponds to the moment of greatest possible organisation (least entropy) of the matter of the universe. Reasons are given for believing that this condition could not have occurred by a fortuitous grouping of the particles of matter. The lecture concludes with a discussion of Heisenberg's Indeterminacy Principle; this does not affect the majority of scientific predictions, since these depend on averaging over large numbers of particles. But a deterministic view of the physical world is not possible, since at any given moment it is impossible to obtain complete information about every particle in the universe. G. C. McV.

2594. Thermodynamic Equilibrium in a Static Einstein Universe. R. C. Tolman. *Nat. Acad. Sci., Proc.* 17. *pp.* 153–160, *March*, 1931.—In continuation of previous work [see Abstract 418 (1931)], the author discusses the conditions for thermodynamic equilibrium between matter and radiation in an Einstein universe, assuming the possibility of the inter-conversion of matter and radiation. The relation between the equilibrium constant, N_0, of a monatomic gas, and the proper temperature T_0, is shown to be given by $N_0 = bT_0^{3/2}e^{-mc^2/kT_0}$, and this relation has the same form in flat space-time and in the gravitational field of a sphere of perfect fluid. The equilibrium concentration of matter is exceedingly low even for masses as small as the electron and for temperatures as high as 40,000,000° C, unless the constant *b* has an extremely large value.

J. S. G. T.

2595. Homogeneous Universe of Constant Mass and Increasing Radius. G. Lemaître. *Roy. Astron. Soc., M.N.* 91. *pp.* 483–490, *March*, 1931.—An English translation of the paper in which the author gave the theory of a homogeneous spherical universe of constant mass and increasing radius, accounting for the radial velocity of the extra galactic nebulæ. In such a universe the expansion is shown to be adiabatic. The increase in the radius of the universe gives rise to an apparent Doppler effect for objects distant from the observer, and, from the observed average rate of recession of the nebulæ, this Doppler effect is known and hence the present rate of expansion of the radius of the universe can be calculated. The expansion began in the infinitely remote past when the universe was an " Einstein universe," *i.e.*, one in which matter was at its maximum concentration. G. C. McV.

2596. The Expanding Universe. G. Lemaître. *Roy. Astron. Soc., M.N.* 91. *pp.* 490–501, *March*, 1931.—The problem of whether the formation of condensations in a homogeneous universe would cause it to start expanding or contracting is dealt with. The line-element of a universe with condensations is defined and, on this basis, it is shown that the mere presence of condensations can have no effect, either way, on the expansion or contraction of the universe, since the rate of expansion of the neutral zone between one condensation and the rest is unaffected. The author finds the cause of the expansion in the diminution of the exchanges of energy between distant parts of the universe which occurs when condensations are formed, and works out the formulæ of expansion in the case when the free energy becomes bound to condensations in an instant. G. C. McV.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

2597. Twilight Luminosity. J. Jaroslawzew. *Gerlands Beitr. z. Geophys.* 29. 2. *pp.* 161–167, 1931.—Tables show the luminosity, in lux measured with a tube-photometer, of morning and evening twilight from the time that, or until the sun was about 8·5° below the horizon, during June, 1926, and August, 1927, at Pavlovsk (59° 4′ N., 30 m.), and in August, 1929, on Mt. Elburz (43° 17 N., 3200 m.). For equal depressions of the sun morning twilight averaged 30 % brighter than evening; the darkest (through cloud), average and brightest twilights are in the ratio 1 : 9 : 10. At sunrise on Elburz luminosity was some 75 % greater than at Pavlovsk.
C. A. S.

2598. Condensation on Nuclei of Varying Size and Determination of their Number. H. Köhler. *Gerlands Beitr. z. Geophys.* 29. 2. *pp.* 168–186, 1931.—It is thermodynamically shown that the condensing powers of nuclei vary according to their size, and hence that the numbers given by the Aitkens counter are doubtful, being those of only the largest nuclei, the smaller nuclei coalescing in the counter. These conclusions are supported by the following phenomena, which are also discussed on non-classical lines: the discontinuity in the temperature gradient occurring below or in the lowest portion of recently formed cloud; the simultaneous existence of layers of cloud at different heights; the sudden decrease in visibility immediately before the formation of cloud; the presence of nuclei in mist; and the decrease in chlorine content with height from the ground in ice deposited in a glazed frost. C. A. S.

2599. Actinometric Measurements in the Atlantic and Indian Oceans. L. Gorczynski. *Arch. des Sciences*, 13. *pp.* 19–51, *Jan.–Feb.*, 1931.—The intensities of solar radiation in gm.cal./cm.^{2}/min., for equivalent thicknesses of atmosphere varying from 0·8 to 3, are tabulated for 187 days during the years 1923–28, at various places in the Atlantic and Indian oceans, India, Siam and Java. From these results the percentages of the solar constant received are calculated. The losses due to mist, dust, etc., average 1 % over the Indian, 2 % over the Atlantic ocean (south of 45° N.), 3 % in the Mediterranean and Red seas, and amount to 5, 7 and 11 % respectively at Apia (Samoa), Bangkok and Warsaw. The apparatus used and methods of testing are described. C. A. S.

2600. Atmospheric Pressure Effect of the Sunspot Period. Part II. S. Hanzlik. *Gerlands Beitr. z. Geophys.* 29. 2. *pp.* 138–155, 1931.—Charts were obtained for the pressure effect around sunspot maximum and sunspot minimum for the three winter (Dec. to Feb.) and the three summer (June to Aug.) months by the same method as before [see Abstract 754 (1931)]. By superposition four types of pressure oscillation can be identified in different regions of the earth. Type A has mostly a positive effect, and in the winter months covers roughly the whole of the Indian monsoon area. The values change from one sunspot period to the next with roughly the Bruckner period. Type D is mostly negative. It covers the area round the southern part of South America with an oscillation in winter opposite to, and in summer the same as, A. The areas A and D cover the field of the Lockyer oscillation. Types B and C have a period double that of the sunspot period (Hale period) and form an oscillation between middle and polar latitudes in winter and summer. The amplitude of the oscillation is dependent on the latitude, increasing from the equator to the poles. R. S. R.

2601. Oscillations of the North Atlantic Circulation and Sunspots. 1881–1923. A. Peppler. *Gerlands Beitr. z. Geophys.* 29. 2. *pp.* 187–200, 1931.—Defant's calculations of the anomalies of meridional pressure differences over the North Atlantic between 30° and 65° N. have been extended to a period of 43 years. The intensity of the circulation is given by the difference between the subtropical high and the Icelandic low pressure areas. The relations obtained by Schostakowitsch and Hanzlik between pressures and sunspot numbers are discussed. Curves illustrate the relations found between the pressures in the two latitudes and the fluctuations of the effect of the North Atlantic circulation (*i.e.*, the difference of mean pressure in three years of sunspot minimum and the following three years of sunspot maximum) and also the relative number of sunspots as given by Hanzlik. Apart from short-period oscillations, the existence of a 7·5-year period, found also at numerous places for pressure oscillations, and of another longer one, possibly identical with the 44·5-year period found by Köppen for severe winters, is shown. It is uncertain whether the relations are of a causal or formal nature. R. S. R.

2602. Horizontal Temperature Differences over Small Distances. A. C. Best. *Roy. Meteorolog. Soc., J.* 57. *pp.* 169–175; *Disc.,* 175–176, *April,* 1931.—With the apparatus used by Johnson [see Abstract 3289 (1929)] the temperatures at three points in the same east–west line, 25 ft. apart and 4 ft. from the ground, were determined during July–September, 1929. During hours of lapse (mainly by day) the temperatures varied very irregularly from minute to minute by 0·1°–2·0° F. During inversions (but only by night) variations were slower, differences of as much as 1·5° F. lasting for periods up to 30 min. At other times the temperatures at all three points would be the same for some hours. Attempts to correlate the variations with cloudiness and wind are made. In the *Discussion*, it was suggested that the nature of the soil might have some effect; and it was stated that similar, but smaller, variations were shown at places only 2–3 ft. apart. C. A. S.

2603. Portable Temperature-Gradient Indicator. E. L. Davies. *Roy. Meteorolog. Soc., J.* 57. *pp.* 177–181; *Disc.,* 181, *April,* 1931.—This paper deals with the design and development of a simple portable vertical temperature-gradient indicator. The method consists essentially of measuring the differences in resistance of two platinum elements exposed at different heights above the ground. The advantages and disadvantages of three types of housing for the resistance elements are given in detail. With the electrically-aspirated housing and a good galvanometer (sensitivity about 2 mm. of scale per microampere), differences of temperature to within 0·1° F. are measurable. AUTHOR.

2604. Uniformity of Rotation of Cup Anemometers. J. Grunow. *Zeits. f. Instrumentenk.* 51. *pp.* 144–151, *March,* 1931.—The anemometer factor increases slightly with decreasing wind velocity due to frictional resistance and mechanical retardation of individual parts. A method is described by which these micro-anemometer oscillations can be measured and the results obtained with several instruments are given. For a wind velocity of 1·9 m./sec. the anemometer constant changes from 2·41 to 24·4 with a mean value of 4·06. Curves show how the anemometer factor alters for different oscillation coefficients and mean wind velocities, where the oscillation coefficient is given by $(\Delta v - \Delta v_1)/(v - v_1)$. It is concluded that instruments must be constructed to give uniform resistance and friction between two contacts, and methods to obtain such conditions are indicated. R. S. R.

2605. Stability of Cyclonic Waves. H. Ludloff. *Ann. d. Physik,* 8. 5. *pp.* 615–648, *March* 18, 1931.—To obtain general ideas regarding polar front meteorology certain idealised conditions are taken. On a disc rotating with constant angular velocity ω, two currents of unchanged composition flow with densities ρ_1 and ρ_2, and velocities U_1 and U_2. Long waves occur at the surface of separation which is inclined to the disc at an angle α. The velocity of the waves is investigated in relation to length, ω, $\rho_1 - \rho_2$, $U_1 - U_2$ and α, and especially to establish whether motion is stable or labile. The waves are assumed long compared with the depth of the air mass and that in turn large compared with the amplitude. Comparable cases are treated before setting out the meteorological problem. A limiting case and two special cases of the general problem are considered and the general problem then discussed. Under normal conditions of temperature and flow waves of length > 1000 km. are stable and < 500 km. labile. Mechanical lability of the system considered appears to occur for short waves and with large velocities. The lability of large cyclonic waves is not simply a hydrodynamical problem of stability on a rotating earth, but thermodynamical processes are important. Oscillation of the stratosphere is important and friction at the earth's surface plays a part. R. S. R.

2606. Stokes' Formula in Geodesy as a Solution of a Limiting Problem. N. Idelson and N. Malkin. *Gerlands Beitr. z. Geophys.* 29. 2. *pp.* 156–160, 1931.—Stokes' fundamental formula giving the distance between the ellipsoid of reference and the geoid, and obtained from observations of gravity anomalies, can be derived as a solution of the third problem at the limits of the potential theory, of which it is only a special case. The solution is simpler than that given by Stokes, Helmert or Poincaré. R. S. R.

2607. Shaping the Earth. W. Bowie. *Washington Acad. Sci., J.* 21. *pp.* 103–125, *March,* 1931.—The author reviews the various ideas regarding the formation of oceans and continents and Dutton's flotation hypothesis regarding isostasy. Pratt's and Airy's views are compared and the measurement of variations of gravity, and the causes of anomalies are discussed. Finally, the effects of tides, temperature of the earth's interior, sedimentation, erosion, temperature changes in the sediments, and movements of sub-crustal material are considered in producing diastrophic forces and consequently elevation or depression of the crust of the earth and earthquakes. R. S. R.

2608. Isostatic Mass Distribution in the Earth's Surface. A. Prey. *Gerlands Beitr. z. Geophys.* 29. 2. *pp.* 201–225, 1931.—Hopfner has stated that isostasy is an illusion due solely to the methods of reduction. To test this statement the author has treated completely the case of a non-isostatic earth. The level surface (geoid) and the values of gravity

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on the surface of continents and oceans are computed by a method involving spherical harmonics, dependent on a mass distribution of the earth where heights are counted from the disturbed level surface and not from the surface of the normal earth. The free air and Bouguer reductions are applied to the values of gravity obtained. In only a few regions of the earth does the result support Hopfner's views and generally the values of gravity found for a non-isostatic earth conflict with the observations. There is an important asymmetry in the N–S and E–W directions caused by terms of the first order in the development. Also values of gravity in America and Europe should differ by about 0·1 cm./sec.^{2}, a result in conflict with observations. These results are held to disprove Hopfner's views on the absence of isostasy. R. S. R.

2609. Theoretical Basis of Isostasy. W. D. Lambert. *Am. J. Sci.* 21. *pp.* 345–349, *April*, 1931.—The validity of observational proof of isostasy has been questioned on theoretical grounds by Hopfner, but his presentation of the mathematical theory is not generally accepted by geodesists. The author quotes Prey's views in support of the idea that the earth is isostatic. The Bruns term, the reduction from the geoid to the spheroid of reference of the gravity formula, can also be applied only qualitatively to explain an observed gravity anomaly. Criticism is also made of Hopfner's identification of the Bruns term with Bowie's reduction, but Heiskanen shows the concepts are different. [See also Abstract 1489 (1931).] R. S. R.

2610. Long Wave in the First Phase of Certain Seismograms. Part II. O. Somville. *Gerlands. Beitr. z. Geophys.* 29. 2. *pp.* 247–250, 1931. *In French.*—Since the publication of Part I [see Abstract 71 (1931)] new observations have been made upon the wave PL which indicate this to be propagated well beyond 1400 km. Tables of data are included. H. H. Ho.

2611. Development of the Wave Conception. Part V. K. Uller. *Gerlands Beitr. z. Geophys.* 29. 2. *pp.* 252–266, 1931.—This paper continues previous work [see Abstract 69 (1931)] and in it is shown how the interference principle determines the number and kind of waves which are possible in a wave family, also how every wave species possesses a special structure. Thermal diffusion, electromagnetic and the two elastic waves are discussed, and in particular those waves which are almost reversible. The paper is entirely mathematical. H. H. Ho.

2612. Deep-Focus Earthquakes. R. Stoneley. *Gerlands Beitr. z. Geophys.* 29. 3–4. *pp.* 417–435, 1931. *In English.*—Theoretically in deep-focus shocks (for which the name bathyseism is proposed) the amplitude of surface waves (L, M, Rayleigh, Love) relative to that of the body waves should be small. This is not always the case in the 17 of the earthquakes reported in the International Seismological Summary up to March, 1927, which are regarded as bathyseisms. It is shown that the theory does not hold in the case of a many-layered earth unless the focus is below these layers, and that where it does not hold there should be abnormalities in these waves. The records of most of these, and of some other earthquakes, are critically examined, and abnormalities as required shown to exist in many cases where the surface waves are of considerable amplitude. The reality of bathyseisms is held to be established. C. A. S.

2613. Diurnal Tide in an Ocean Bounded by Two Meridians. D. C. Colborne. *Roy. Soc., Proc.* 131. *pp.* 38–52, *April*, 1931.—General dynamical equations are obtained by the introduction of certain null functions for diurnal tides in an ocean on a rotating globe bounded by two meridians from pole to pole. The method was used previously by Goldsbrough [see Abstract 1767 (1930)] for semi-diurnal tides, the meridians in both cases being 60° apart. Theoretical results show that diurnal tide has less amplitude than semi-diurnal. Where possible, results are compared with actual tides in parts of the Atlantic ocean, which approximate to the theoretical conditions, and the ratio of the heights of the two tides is in accord with theoretical results. The wave is equivalent to the combination of a stationary wave and a progressive wave of much smaller amplitude; this results in periods when neither high nor low tide occurs at any point in the ocean. H. M. B.

2614. Interference in the Solar Corona. W. R. Wright and H. D. Curtis. *J.O.S.A.* 21. *pp.* 154–170, *March*, 1931.—At the Mexican eclipse of 1923, and at three later eclipses, the authors used interferometers of various designs in order to investigate the rotation of the corona by observing the interference pattern due to the comparatively strong coronal lines 5303 Å. and 3388 Å. The instruments and methods used are described in detail, and although the results so far are negative, it is believed that success may be obtained by modifying the apparatus and improving the methods. M. A. E.

2615. Electrical State of the Sun. R. Gunn. *Phys. Rev.* 37. *pp.* 983–989, *April* 15, 1931.—The magnetic field due to the rotation of our galaxy is calculated, and it is shown (*a*) that electricity cannot be annihilated in the sun or stars; (*b*) that the net electrical charge on the sun or a typical star cannot exceed 1 coulomb. The electric fields, space charge and potentials of the solar atmosphere are calculated from data relating to the solar anomalous rotation and numerical values given. The negative surface charge on the sun is calculated to be of the order of 10^9 e.m.u. The problem of the maintenance of the solar electric field is touched upon. AUTHOR.

2616. Widths of Lines in the B (Atmospheric Oxygen) Band in the Solar Spectrum. R. v. d. R. Woolley. *Mt. Wilson Observat., Contrib. No.* 420. *Astrophys. J.* 73. *pp.* 185–193, *April*, 1931.—The widths of individual lines composing the B band in the solar spectrum have been measured at various solar zenith distances in order to test Unsöld's formula. It is found that whereas the formula leads to a width proportional to the square root of the number of absorbing atoms, the measurements give a width proportional to the three-eighths power. A similar deviation from the formula, but increasing with decreasing line-width, would account for the anomalous intensity-ratios of weak multiplet lines. [See also Abstract 75 (1931) and following Abstract.] R. d'E. A.

2617. Widths of Weak Fraunhofer Lines. R. v. d. R. Woolley. *Mt. Wilson Observat., Contrib. No.* 421. *Astrophys. J.* 73. *pp.* 194–204, *April*, 1931.—Since the Unsöld formula does not correctly represent the dependence of line-width on number of absorbing atoms, in the case of weak lines [see preceding Abstract], possible causes of the disagreement are looked into. The Doppler effect and limited resolving power are both insufficient to account for all of the discrepancy, at least for lines stronger than 2 on Rowland's scale. "Interlocking" of the different terms of a multiplet (which would invalidate parts of the Adams-Russell calibration of Rowland's scale) appears to have actually a negligible effect. Unsöld's theory may, however, be wrong in assuming that an atom always emits exactly the same part of the line that it last absorbed. Since his formula does break down independently of the validity of the Adams-Russell calibration, the cause is probably to be sought at this point, though it is doubtful whether the assumption mentioned is responsible. If the failure lies in Unsöld's theory, it does not invalidate the Adams-Russell calibration. R. d'E. A.

2618. Expansion of the Disturbing Function in Terms of the True Longitude of the Disturbed Planet. C. A. Shook. *Roy. Astron. Soc., M.N.* 91. *pp.* 553–558, *March*, 1931.—The method of performing this expansion is explained, and it is written out to the second order. It is planned to extend it to a higher order in the near future. The paper is purely mathematical. M. A. E.

2619. Three-Body Problem. K. Bohlin. *Astron. Iakttagelser Undersökning, Stockholm*, 11. 7. [31 *pp*.], 1931.—The orbits of the three bodies, which are of equal mass, are worked out in detail, the equations of motion being solved numerically. One of the three bodies is taken to be considerably further from the common centre of gravity than the other two. The orbit of this body soon becomes extremely large, but remains elliptical. Tables of the solution are given as well as diagrams of the orbits. [See also Abstract 2656 (1924).] G. C. McV.

2620. Apparent Radiants of Great Meteors. V. G. Siadbey. *Comptes Rendus*, 192. *pp*. 608–611, *March* 9, 1931.—The author obtains additional results [see Abstract 777 (1931)] from his study of Niessl and Hoffmeister's Catalogue of Great Meteors. In many cases no account has been taken of the correction for zenithal attraction in computing the elements of apparent radiants. Near the equator between declinations 0° and + 19° there are (I) many radiants between R.A. 0° – 22°·5 and R.A. 337°·5 – 360°, but there are (II) few radiants between R.A. 157°·5 – 180°. Near the ecliptic there is a concentration of radiants (to which (I) is due), but this fails in the case of area (II). The two quadrants in the northern hemisphere containing the Milky Way are richer in radiants than the other two. There is a marked concentration of radiants near the Anti-Sun, and if we assume that the distribution of radiants is uniform over the whole heavens we fail to observe more than a hundredth of those seen near the Anti-Sun. A. S. D. M.

2621. Four Spectroscopic Binary Orbits. W. E. Harper. *Dominion Astrophys. Obs. Victoria, Publ.* 4. 19. *pp*. 309–323, 1930.—The stars are *b* Persei, Boss 613, H.R. 1401 and H.R. 3352. The orbit of the first was published by Cannon at Ottawa, the second was announced as binary from Victoria, whilst the third and fourth have not hitherto been announced as of binary character. In the case of *b* Persei, Cannon found on some plates the spectrum of the second component from which a mass ratio of 3·6 to 1 was obtained. Victoria plates do not show such secondary spectrum. An improved period of 1·52738 days is obtained, but even then all early observations cannot be satisfied. There appear to be orbital changes taking place, as the velocity of the system in 1930 is 9·6 km. more negative than in 1911. The periods of the other three stars are, respectively, 2·53636, 4·195 and 4·285 days, with nearly circular orbits in each case. The spectral types are A2, A5 and A5, and numerous good lines for measurement make possible probable errors of a plate from ± 1·8 to ± 2·0 km. per sec. The coordinates of position, magnitude and types for the four stars are tabulated. AUTHOR.

2622. Galactic Rotation Effect in Some Late-Type Stars. R. O. Redman. *Dominion Astrophys. Obs. Victoria, Publ.* 4. 20. *pp.* 325–340, 1930.—A description is given of the observation and analysis of the radial velocities of some 200 seventh-magnitude K stars situated near the galactic equator. A small dispersion spectrograph was used and only one plate was taken of each star. The " probable error " per plate is estimated as 3·5 km./sec. Solutions for the solar motion and " galactic rotation " confirm the high declination of the solar apex and high value for l_0, the longitude of the galactic centre, found with late-type stars by other workers, who have used principally proper motions. The " rA " term agrees satisfactorily with other estimates. The average peculiar radial velocity of these stars is about 20 km./sec. (four were found > 100 km./sec.), and there are definite signs of stream motion. It is significant that in all work on late-type stars the l_0 agrees better with the apices of stream motion than with the usually accepted galactic centre. AUTHOR.

2623. Y Cygni. R. O. Redman. *Dominion Astrophys. Obs. Victoria, Publ.* 4. 21. *pp.* 341–350, 1930.—This paper describes the results of recent spectroscopic observations of the eclipsing variable Y Cygni (1900. $20^h\,48^m\cdot 1$, + 34° 17′, $7^m\cdot 1$, O9). Orbital elements are calculated and are found to agree very satisfactorily with the photometric results of Dugan, in particular with regard to eccentricity and the motion of periastron. The velocity of the centre of gravity of the eclipsing pair is found to be changing, indicating the presence of a third body. The absolute dimensions and parallax of the two principal stars are obtained and a brief discussion made of the possible nature and importance of the third member of the system. AUTHOR.

2624. Meridian Observations of Comparison Stars for Eros. G. Armellini and Gabriella Armellini Conti. *Accad. Lincei, Atti,* 13. *pp.* 3–7, *Jan.* 4, 1931.—In preparation for the near approach of Eros in January, 1931, a list of comparison stars was drawn up by Kopff, and the Observatory of Campidoglio undertook to determine the positions of thirty of these. Observations were made on forty evenings of 1929 and 1930, chiefly by G. Conti, who also made all the reductions. The positions in R.A. and Dec. for epoch 1930·0 are shown in a table. M. A. E.

2625. Variable Star Y Sagittarii. G. Tiercy. *Arch. des Sciences,* 13. *pp.* 5–18, *Jan.-Feb.,* 1931.—Nineteen plates were taken in 1927 by the author in the Arcetri series. Prager's elements are used, and formulæ and methods are as in previous memoirs [see Abstract 2967 (1928)]. The light curve is similar to that found by Luizet, but a slight secondary undulation on the descending branch is indicated. The mean spectral type is F8; and the mean radius is 18·9, the sun's being taken as unity. For the author's colour index formulæ, see Abstract 1475 (1929). Tables are given of the star's temperature and pressure (about 0·003 atm.) and photographic magnitude. A. S. D. M.

2626. Incomplete Polytropes. A. S. Eddington. *Roy. Astron. Soc., M.N.* 91. *pp.* 440–444, *March,* 1931.—The amount of the potential energy of a distribution of matter of given mass and radius arranged as a series of polytropic regions of different indices one within the other, is calculated. It is assumed that the density, temperature, etc., are finite at the centre. The value of the potential energy found shows that the index of the outermost polytropic region is greater than that of the innermost. In this way, it is claimed that Milne's " centrally condensed " star-models, of perfect gas (index 3) outside a degenerate gas core (index $\frac{3}{2}$), are impossible in nature. The method of proof of the theorem follows closely that used by Emden for the simpler case of a distribution with a single polytropic region. G. C. McV.

2627. Upper Limits to Central Temperature and Density of a Star. A. S. Eddington. *Roy. Astron. Soc., M.N.* 91. *pp.* 444–446, *March,* 1931.—By calculating the central pressure of a star of given mass, under the assumption that the density is uniform throughout the star and that the material is degenerate gas, the author arrives at a maximum density of the order of 10^7 gm./cm.^{3} and maximum temperature of 10^9 ° C. for the star. If the material is not a degenerate gas these upper limits must be reduced. G. C. McV.

2628. Dissociation Formula according to Relativistic Statistics. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 91. *pp.* 446–455, *March,* 1931.—The high temperatures in the cores of Milne's highly collapsed star models are just the temperatures at which the relativistic effect becomes important in statistical theory—at any rate as far as the electron assembly is concerned. Assuming that the atomic assembly obeys the non-relativistic equations and the electron assembly the relativistic, the dissociation formulæ for the mixture are worked out. The conditions for the electron assembly are four in number, since the relativistic effect may be either of the second order or predominant and, in each case, the assembly may be either degenerate or non-degenerate. Applied to Milne's highly collapsed star-models, the theory shows that the temperature at the interface between perfect and degenerate gas is high enough to justify the assumption that the core is actually composed of degenerate gas, whilst the values of the central temperature and density show that the electron assembly is degenerate and the relativistic effect predominant at the centre. G. C. McV.

2629. Solutions of Milne's "Equations of Fit" for Standard Model. B. Strömgren. *Roy. Astron. Soc., M.N.* 91. *pp.* 466–472, *March,* 1931.—The same results with regard to the fitting of perfect gas envelopes on to cores of degenerate gas as were found by Cowling [see following Abstract] are deduced by a method depending on certain theorems discovered by R. H. Fowler [see Abstract 1142 (1931)]. G. C. McV.

2630. Fitting of Polytropic Models in Theory of Stellar Structure. T. G. Cowling. *Roy. Astron. Soc., M.N.* 91. *pp.* 472–478, *March,* 1931.—Milne has shown [see Abstract 1140 (1931)] that star-models of " standard " type consisting of perfect gas can have very high central densities and temperatures and has suggested that in such " centrally-condensed " models infinite density at the centre can be avoided if the model is supposed to have a core of degenerate gas. It is now shown, by a discussion of Milne's " equations of fit " for the continuity of density, temperature, etc., at the interface between perfect and degenerate gas, that a " centrally condensed " solution in the perfect-gas envelope implies a similar solution in the degenerate-gas core. In this way, the singularity at the origin still persists. If the perfect-gas envelope solution is of " collapsed " type, it is always possible to find a solution in the core giving a finite central density. These results are proved directly by the use of the solution curves of the first order equation which is equivalent to Emden's equation of index *n*. [See also preceding Abstract.] G. C. McV.

2631. Rotation of Stars. E. A. Kreiken. *Roy. Astron. Soc., M.N.* 91. *pp.* 501–518, *March,* 1931.—The correlation already found [see Abstract 1509 (1931)] between the period of axial rotation and of revolution for spectroscopic binaries or of light variation for Cepheid variables and long-period M-type variables, is further confirmed by the use of more extensive material. The formula connecting the logarithms of the period of axial rotation (P) and the diameter of the star (D) is corrected to allow for the fact that only the part of the rotational velocity in the line of sight can be observed. In the case of spectroscopic binaries it is found that a marked correlation between period of axial rotation and period of orbital revolution exists for systems of low eccentricity, but, with increase of eccentricity, the correlation becomes less and finally disappears. This is evidence in favour of Jeans' theory of fission for the origin of these systems. For Cepheids the period of light variation is found to be considerably shorter than the period of axial rotation obtained from the formula. For long-period variables either the period of light variation is shorter than the period of axial rotation or the period of axial rotation is shorter than that given by the formula. The author concludes that the relation $\log P = 1\cdot49 \log D - 1\cdot45$ gives the critical value of the period of axial rotation in the process by which a variable develops into a spectroscopic binary. Further, long-period variables, Cepheids and β Canis-Majoris stars represent groups of stars which separately can develop into spectroscopic doubles. G. C. McV.

2632. Effect of Atmospheric Absorption in Stellar Spectro-Photometry. J. Dufay. *Roy. Astron. Soc., M.N.* 91. *pp.* 549–552, *March,* 1931.—Attempts to correct observations in stellar spectrophotometry for the effect of differential absorption have recently been made by several astronomers, but the treatment adopted can only be regarded as an empirical approximation. The spectrophotometric temperature of a star is determined by means of the gradient relative to a standard comparison star at a given temperature, but since observed gradients vary with the zenith distances of the stars, a correcting term is added to find the true gradient. The right method, although longer and much more laborious, is to correct separately each observed value of the magnitude difference before computing the gradient. The important researches recently undertaken by English astronomers merit the most accurate reduction. M. A. E.

2633. Astronomical Refraction. A. Fletcher. *Roy. Astron. Soc., M.N.* 91. *pp.* 559–562, *March,* 1931.—The author writes the usual equation for R at apparent zenith distance ζ in the form

$$R = -\sin\zeta\int(d\nu')(\sqrt{2u + \cos^2\zeta})^{-1},$$

where $\nu' = \log_e \mu$; and making the nearly Laplacian hypothesis that $\nu' = C(1 + fu/l)e^{-u/l}$, he finds by integration

$$R = C \sin \zeta [fT + 2(1 - \tfrac{1}{2}f - fT^2)\psi(T)](\sqrt{2l})^{-1}; \psi(T) = e^{T^2}\int_T^\infty e^{-t^2}dt.$$

If the suffix 0 be used to denote a value at the place of observation, and H_0 is the ratio of the height l_0 of the homogeneous atmosphere to r_0, refraction depends at moderate zenith distances simply on ν_0 and H_0; it depends appreciably up to about $\zeta = 85°$. The author connects the quantities C, l, f, in the above formula with ν_0, H_0 and horizontal refraction. For $\zeta > 85°$ it becomes of decreasing importance that the fictitious atmosphere should have the right H_0 and of increasing importance that it should have the right μ in the first few km. A. S. D. M.

2634. Star Streaming in Galactic Zones. R. D. H. Jones. *Roy. Astron. Soc., M.N.* 91. *pp.* 563–568, *March*, 1931.—An examination of the proper motions of Boss' Preliminary General Catalogue for star streaming, the heavens being divided into four zones parallel to the galactic equator, and subdivided by galactic meridians, not as done by Eddington, into regions demarcated by meridians and parallels of declination. The four zones of galactic latitudes are: (I) + 10° to − 10°; (II) + 10° to + 30° and − 10° to − 30°; (III) + 30° to + 60° and − 30° to − 60°; (IV) + 60° to + 90° and − 60° to − 90°. Separate solutions have been made for zones I, III, and IV (as well as for the whole) so as to test variation in the motion of star streams with distance from the galactic equator. This shows a decrease in Drift I velocity from 1·727 at the galactic equator to 1·415 at the poles; the elements of Drift II are not sufficiently determinate to show any similar variation. The four zones together give the following constants (Eddington's values in brackets):

$hV_1 = 1{\cdot}536 \pm 0{\cdot}036\ (1{\cdot}516)$; $hV_2 = 0{\cdot}851 \pm 0{\cdot}039\ (0{\cdot}855)$;
$\alpha_1 = 88°{\cdot}9 \pm 1°{\cdot}9\ (90°{\cdot}8)$; $\alpha_2 = 279°{\cdot}4 \pm 4°{\cdot}2\ (287°{\cdot}8)$;
$\delta_1 = -18°{\cdot}3 \pm 1°{\cdot}4\ (-14°{\cdot}6)$; $\delta_2 = -54°{\cdot}1 \pm 2°{\cdot}6\ (-64°{\cdot}1)$.
Vertex of Star Streaming; R.A. = 91°·7 ± 1°·4 (94°·2);
Dec. = + 6°·1 ± 1°·6 (+ 11°·9).
Solar Apex, R.A. = 266°·5 (267°·3); Dec. = + 37°·4 (+ 36°·4).

The velocity relation of the two drifts = 1·962 ± 0·053 (1·87). A. S. D. M.

2635. Red Shift (K Effect) in B Stars of the Perseus and Scorpius-Centaurus Star Streams. K. F. Bottlinger. *Zeits. f. Astrophysik*, 2. 2. *pp.* 151–160, *March* 2, 1931.—In a star stream of well-defined convergence point the true radial velocities can be obtained from proper motion and distance from the convergence point. A comparison with the radial velocities inferred from the Doppler effects allows the K effect to be obtained. The results are given for a large number of stars in both streams, but only a small number are regarded as accurate enough (as judged by mean error in observed radial velocities) to establish any conclusion. Eighteen stars in each stream gave K effects of 2·77 ± 1·06 and 2·37 ± 1·04 km./sec. respectively; if this is a relativity shift it corresponds to about four times the sun's value of M/R. A few stars, apparently very heavy for their luminosities, seem to have a much larger effect; it is suggested that they may be generically in the " white dwarf " class.

R. d'E. A.

2636. Secular Changes of Brightness in Cepheid Variables. E. Zinner. *Preuss. Akad. Wiss. Berlin, Ber.* 9. *pp.* 182–199, 1931.—In former papers it has been shown [see Abstract 3377 (1930)] that a comparison of the observations made by Ptolemy, Sufi and modern astronomers indicates that supergiants have increased continuously in brightness, and dwarfs have decreased. The case is rather different with Cepheids, for those with shorter periods have continuously increased, but those with longer periods have decreased, in brightness, even if they are supergiants. Four Cepheids have been investigated from this point of view, *viz.*, the Pole Star, δ Cephei, η Aquilæ, and ζ Geminorum; and the results obtained by comparing ancient with recent observations are confirmed by comparing observations made between 1840 and 1928. It is suggested that the rapid periodical light-changes of these stars, which also have a continuous secular change, may be of the same nature as the periodical fluctuations often shown by new stars after they have reached their brightest stage and are beginning to decline. M. A. E.

2637. Ultra-Violet, Blue and Yellow Magnitudes in the Cluster h Persei and the "Ultra-Violet Appendage." C. Jane Anger. *Harvard Coll. Obs., Bull. No.* 882. *pp.* 1–15, *April* 1, 1931.—Is the yellowish colour discovered in many of the early B stars caused by local or space scattering, or is it intrinsic in the stars? The double cluster in Perseus offers an excellent opportunity to study this problem. Photographs were obtained by Miss Payne with ultra-violet and yellow filters, and without filter, and the colour indices have been compared with the photographic magnitudes by the writer. It seems quite clear that the ultra-violet colour index is definitely correlated with absolute magnitude, and that stars tending to have emission lines are stronger both in yellow and in blue than normal stars. Thus the relative strength of the yellow in the brightest B stars appears to be a real effect, probably connected with absolute magnitude, and colour excess cannot be used as an indication of space reddening, as was done by Trumpler (*Lick Observat. Bull.* No. 420, 1930). Gerasimovič observed that the spectra of many early B and O stars show an increase in strength in the ultra-violet, and suggested that this "ultra-violet appendage" is due to the decrease of continuous hydrogen absorption (which is strong in Ao stars), also that there may be a real excess of ultra-violet radiation in some B and O stars. His microphotometer tracings have been examined, and it is found that the "appendage" can be explained by differential absorption in the glass of the prism used. Yellow and ultra-violet colour indices have been deduced from his tracings, and the results accord with those found from the h Persei stars. M. A. E.

2638. Photographic Light Curves of Cepheid Variables. Part VII. L. V. Robinson. *Harvard Coll. Obs., Bull. No.* 882. *pp.* 15–20, *April* 1, 1931.—In continuation of previous papers light curves and elements for nine more Cepheids are given, with notes on each. M. A. E.

2639. Yerkes Actinometry. Second Series. A. S. Fairley. *Astrophys. J.* 73. *pp.* 125–184, *April*, 1931.—The photographic magnitudes of all stars (2354 in number) down to magnitude + 8·25 in the zone + 75° to + 60° have been determined by the method of extra-focal images. The plates were calibrated by a series of sensitometer exposures, the zero-point being obtained from those stars of the *Potsdam Photometric*

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Durchmusterung that appeared on each plate. Each star appeared on six plates on the average, and the average probable errors, classified in various ways, are nearly all less than 0·04 m. A classification according to spectral type shows probable errors that are largest for red stars; it is suggested that a large number of these stars may be small-range irregular variables. Comparison with the visual magnitudes of the Harvard Revised Photometry gives colour indices; these do not correlate very closely with spectral type. R. d'E. A.

2640. Twinkling. E. H. Synge. *Phil. Mag.* 11. *pp.* 957–961, *April*, 1931.—Hitherto this phenomenon has been treated as one of geometrical optics, and the author shows that neither simple refraction nor actual interfering pencils of light can be the cause, but that it is essentially a phenomenon of diffraction, the atmosphere acting as an ever-varying diffraction screen. Small atmospheric disturbances do not alter the directions of the wave-front by more than a few seconds of arc, but may at the same time alter widely the intensity at various parts of the wave-front, and quite differently for different wave-lengths. He shows how this explains why stellar spectra taken near the horizon may be crossed by interference bands which go from blue to red for a rising and the reverse direction for a setting star. He refers to his previous papers [see Abstracts 105 and 1503 (1931)], and in connection with the first of these he indicates why superior detail may be got on photographs of Mars with long wave-lengths over those with short. It is conceivable that the fullest theoretical resolution might be attained in the infra-red, for the largest instrument of the kind suggested (the *Synthescope*) in ordinary good conditions, and in occasional very good conditions even for the short wave-lengths.

A. S. D. M.

2641. Condensed Stars. E. C. Stoner and F. Tyler. *Phil. Mag.* 11. *pp.* 986–995, *April*, 1931.—The effect of assuming variable density in the type of stars previously studied by the authors [see Abstract 3088 (1930)], under the assumption that the density was constant is discussed, and provisional conclusions are given. For a star less than half the sun's mass the distribution of density is that of a 5/3 polytrope. The limiting central density is about four times as great, the mean density about half as great as that calculated for stars of uniform density. For stars of somewhat greater mass the mean density will also be smaller, but no conclusion as to limiting mass can be drawn. For completely condensed stars the equilibrium mass for a given mean variable density is slightly less than if the density is assumed to be constant. G. C. McV.

LIGHT.

2642. Spectral Transmission of Absorbing Glass (Jena 7839) in the Visible Spectrum. G. Ribaud. *Rev. d'Optique,* 10. *pp.* 162–167, *April,* 1931.—Curves showing the relations of τ_λ (spectral transmission), $\log 1/\tau_\lambda$ (spectral density) and $\lambda \log 1/\tau_\lambda$ with the wave-length λ, for values of λ from 4500 to 7000 Å., are given for Jena 7839 glass, 3 mm. thick. $\text{Log } 1/\tau_\lambda$ increases by 50 % between the extreme red and violet. $\lambda \log 1/\tau_\lambda$ varies by only 1 % between 4250 and 5000 Å. (*i.e.*, within the limits utilised by the ordinary violet glass), increases linearly by 7 % between 5000 and 6000 Å. (limits for green glass), and decreases similarly by 3 % between 6000 and 7000 Å. (limits for red glasses). Transmission-factor/colour-temperature curves for the same glass with one and two thicknesses (each 6 mm.) of green Jena 4930 glass show between 1500 and 6000° K. decreases of 4·5 and 6·8 % respectively; transmission with two thicknesses is about 1·5 % of that with one. [See also following Abstract.]

C. A. S.

2643. Extrapolation to High Temperatures with Absorbing Glasses: Graduation of a Disappearing Filament Pyrometer for Various Wave-Lengths. G. Ribaud. *Rev. d'Optique,* 10. *pp.* 168–177, *April,* 1931.—T, the temperature as measured with an absorbing glass, and θ, the real temperature, are connected by the relation $1/T - 1/\theta = \lambda/c \log 1/\tau_\lambda$. A formula for the variation of $1/T - 1/\theta$ with T is deduced, showing it to depend on the slope of the $\lambda \log (1/\tau_\lambda)/\lambda$ curve for the absorbing glass, *e.g.*, Jena 7839 [see preceding Abstract], the spectral density of the same, and the differences in effective wave-lengths of the coloured glass at T and T′ (the higher temperature). Combining Jena 7839 with an ordinary violet glass the error in temperature is practically nil; with red Jena 4512 and green Jena 4930 the errors for temperatures of 1900° and 2600° K. are approximately 1·2° and − 3·1° respectively. Formulæ are given for graduating for glasses of other colours a pyrometer graduated for glass of one colour, and also a summary of the operations necessary for graduation *ab initio.* C. A. S.

2644. Obscuring Power and Particle Number and Size of Screening Smokes. P. D. Watson and A. L. Kibler. *J. Phys. Chem.* 35. *pp.* 1074–1090, *April,* 1931.—The object of the experimental work described in this paper is to check the theoretical assumption that the screening power of smokes and clouds is simply related to their particle number and size, and determinations of the numerical value of this relationship are given for smokes of zinc chloride, white phosphorus, titanium tetrachloride, ammonium chloride, oleum and chlorosulphuric acid. For smokes consisting of spherical particles of diameters within the range of the wave-lengths of visible light the average of the screening ratio is 1·27 (calc., 1·35), the screening power being independent of the composition of the smoke particles, but dependent solely upon their number and size. Data are given on the absorption of moisture by hygroscopic smoke particles, the composition of smoke particles, the efficiency of dispersion and the stability of smoke clouds. The precipitation in the experimental smoke chamber was found to follow a logarithmic law, according to which the logarithm of the amount remaining in the air at any given time was proportional to the time. H. H. Ho.

2645. Photoelectric Determination of the Opacity of Liquids. P. Jakuschoff. *V.D.I.* 75. *pp.* 426–428, *April* 4, 1931.—The author summarises the history of the discovery of photoelectric phenomena. The extreme sensitivity of the photoelectric cell renders it specially suitable for the determination of the opacity of liquids containing solid matter in suspension, and the degree of saturation or coloration of solutions. N. Kalitin's method for the determination of the opacity of liquids depends on the deflection produced in a galvanometer in the circuit of a photoelectric cell illuminated by a beam of light passing through the liquid in question. The conditions being standardised, a calibration curve can be used to convert the galvanometer deflection to degrees of opacity. The size of the particles has a great influence, however, on the absorptive power of suspensions. A full description is given of the apparatus used, with a potassium-coated cell, to determine the opacity of emulsions. Data from tests with aqueous emulsions of gum mastic and milk are included. The method is applicable to the determination of the saturation of colourless as well as coloured solutions. Results accurate within 0·005 to 0·0001 % can be obtained with the apparatus described, and almost any higher accuracy desired can be obtained by increasing the amount of liquid and the intensity of illumination. Other possible applications of the method are suggested. R. E. N.

2646. Measurement of Refraction of Isotropic and Anisotropic Crystals with the Crystal Interference Refractometer. P. Wulff. *Zeits. f. Krist.* 77. 1–2. *pp.* 61–83, *April*, 1931.—Detailed description of an apparatus, the basic principle of which is that the crystal under investigation is placed in an embedding medium of varying composition. Agreement of the index of refraction of the medium and that of the crystal is registered by a Haber-Löwe interferometer. One bundle of rays traverses medium plus crystal, whereas the other goes through the medium only. [See also following Abstract.] F. I. G. R.

2647. Refraction Measurements upon Crystals. P. Wulff and A. Heigl. *Zeits. f. Krist.* 77. 1–2. *pp.* 84–121, *April*, 1931.—A very extensive series of observations using the apparatus described by Wulff [see preceding Abstract]. The following compounds have been subjected to test for molecular refraction: KF, KCl, RbCl, CsCl, SrF_2, BaF_2, $CaCl_2$, $SrCl_2$, $SrCl_2 . 2H_2O$, $SrCl_2 . 6H_2O$, $BaCl_2$, $BaCl_2 . 2H_2O$, $NaClO_4$, NH_4ClO_4, $Ba(ClO_4)_2 . 3H_2O$, K_2SO_4. Two important results emerge: (1) the fluorides and chlorides of the alkaline earths obey the laws already accepted for the alkali halides, and (2) the ammonium ion, in perchlorates and sulphates (rhombic), behaves irregularly. This effect is discussed in the light of Goldschmidt's suggestion of " contrapolarisation."

F. I. G. R.

2648. Indices of Refraction of Liquids. M. Masius and W. E. Lawton. *J.O.S.A.* 21. *pp.* 232–239, *April*, 1931.—The use of the formula given in an earlier paper [see Abstract 3382 (1930)] is not convenient because A, the total external angle of the prism, must be measured with the same accuracy as δ, the deviation, and measurements of $(\alpha + \beta)$ and g require additional adjustments and methods or auxiliary apparatus. It is shown how the refractive index n may be reduced to the measurement of three similar quantities (minimum deviations) instead of four dissimilar, A, δ, $(\alpha + \beta)$ and g. Also, when n is known accurately for a few liquids the values of n for all other liquids are found by an exact interpolation formula, the use of which requires only one measurement for each liquid. The case is taken where each of the three angles of the prism differs from 60° by $< 10'$. In tests made the values for n never differed by $> 1 \times 10^{-6}$ and were usually less. R. S. R.

2649. Refraction of Light in H_2, O_2 and CO_2 and their Temperature Coefficients. M. Trautz and A. v. Dechend. *Zeits. f. techn. Physik,* 12. 5. *pp.* 243–249, 1931.—Measurements of refractive indices for H_2, O_2 and CO_2 with light of 5461, 5876, 6564 Å., with a Rayleigh-Haber gas interferometer (Zeiss) were first carried out 18 years ago. The method is now repeated and explained more fully with special reference to temperature effects. In the earlier experiments results show a marked difference as to the effect for the three gases. There is a very good agreement between this method and that of Tausz and Görlacher when the temperatures are the same in both cases, also after reducing $(n - 1)$ to that of an ideal gas, a decrease of $(n - 1)$ is found with increase of temperature, and this, while it still requires further investigation, may be explained by the dipole theory with regard to direction and size. H. M. B.

2650. Sensitive Method of Determining the Retardation of a Weakly Birefringent Plate. G. Szivessy. *Zeits. f. Krist.* 77. 3–4. *pp.* 239–254, *April,* 1931.—A mica plate of known retardation G is placed between crossed nicols, covering only half the field, and of which the azimuth β of the axial plane relative to the principal section of the nicols can be measured. The plate of which the retardation g is to be measured is placed above or below the mica plate with its principal section at 45° to the principal section of the nicols, and illumined with parallel light of wave-length λ. Provided that $\tan \pi G/\lambda > \tan 2\pi g/\lambda$, there are eight positions of the mica plate for which the intensities of both halves of the field are the same; four of these are the extinction positions, the other four, β', lie symmetrically to the bisecting line of the two non-contiguous quadrants bounded by the extinction azimuths. G is then given by $\tan 2\pi g/\lambda = \pm \sin 2\beta' \,.\, \tan \pi G/\lambda$. As an example the retardation (0·01155) of a mica flake is evaluated. [See Abstract 987 (1930).]

C. A. S.

2651. Optical Activity of Electrolytes. N. Campbell. *J. Phys. Chem.* 35. *pp.* 1143–1155, *April,* 1931.—The work done on the rotatory power of optically active electrolytes is reviewed, and the merits of the theories advanced to account for the rotation variations are discussed. Experimental work on the rotations of ammonium α-bromocamphor-π-sulphonate is then described. In aqueous solutions below molar concentrations of 0·1 there is little or no variation in the value of the molecular rotation, a fact in agreement with the results of other investigators on the tartrates, etc. The changes observed at greater concentrations may be adequately explained either by variation in the degree of ionisation, or by Darmois' deformation theory. The effect of adding optically inactive salts and non-electrolytes has been investigated, but the regularities observed by other authors have not been observed. Non-electrolytes have a decided influence. The optical rotatory power of the ammonium salt in aqueous alcoholic solutions has been examined. H. H. Ho.

2652. Influence of Polar Solvents on the Rotatory Power of *l*-Menthyl Methyl Naphthalate. H. G. Rule and A. McLean. *Chem. Soc., J. pp.* 674–691, *April,* 1931.—The values of $[M]^{20°}_{5461}$ of *l*-menthyl methyl naphthalate, measured in a number of solvents, are found to vary from − 219° in nitromethane to − 788° in decalin. In the majority of cases, the fall in rotation varies with the dipole moment of the solvent, becoming less pronounced for a given polar substituent as the molecular volume of the hydrocarbon radical increases. For solvents of the same type, a rough approximation to a smooth curve is obtained when rotatory powers are plotted against dipole moments. The depression caused by associated solvents is greatly increased on dilution with a non-polar medium, and it is possible to follow the process of dissociation of the complexes polarimetrically. The curves obtained are similar to those for the change of polarisation undergone by the polar liquid. Special effects observed among homologous and isomeric solvents (such as a screening action of alkyl on adjacent polar groups) are discussed. It is assumed that the sensitivity of the di-ester towards solvents is intimately connected with disturbances in the mutual relationship of the peri-groups, probably caused by electrical deformation or dipole association. C. B. A.

2653. Magnetic Polarisation of Higher Homologues of Fatty Acids. C. Salceanu. *Comptes Rendus,* 192. *pp.* 675–677, *March* 16, 1931.—Gives a table showing for each of the five fatty acids studied, for a low and for a high temperature, the magnetic rotation of the plane of polarisation of light of wave-length 578 mμ, the ratios of these rotations to that of water at 20° C., Verdet's constant ρ, and $\rho_s = \rho/d$, where d is the density at the temperature of the experiment. It appears that ρ_s is practically the same at the lower and higher temperatures of observation, for each acid. The acids dealt with had the following molecular magnetic rotations M, the second number being the difference between the values of M for successive acids in the list: decanoic acid, $C_{10}H_{20}O_2$, 10·57°, 2·06°; lauric acid $C_{12}H_{24}O_2$, 12·63°, 2·03°; myristic acid, $C_{14}H_{28}O_2$, 14·66°, 2·01°; palmitic acid, $C_{16}H_{22}O_2$, 16·78°, 1·98°; stearic acid, $C_{18}H_{36}O_2$, 18·65°. It will be seen that the differences diminish as the molecular weights increase, so that Perkin's law does not hold exactly. H. N. A.

2654. New Magneto-Optical Effect. Rotatory Power of Certain Uniaxial Crystals along the Optical Axis, near the Absorption Bands, under the Action of a Transverse Magnetic Field. J. Becquerel and L. Matout. *Comptes Rendus,* 192. *pp.* 937–939, *April* 20, 1931.—The crystal plate is cooled in liquid nitrogen, which enables fine absorption bands to be obtained. In a gas a transverse magnetic field produces magnetic double refraction about the absorption lines, but with certain uniaxial crystals there is a rotation of the plane of polarisation of the transmitted light. The effect is most marked with xenotime, but is observed feebly with tysonite and rubies. The rotatory power is essentially a function of the orientation of the incident vibration, which is regarded as a very strange result. The rotatory power is in all cases independent of the direction of the magnetic field. The rotatory dispersion in the neighbourhood of different bands, or of the same band for different orientations of the polariser, shows the most varied characters; the rotatory powers are sometimes in the same and sometimes in opposite directions in different portions of the components of a band. Further experiments are being made. H. N. A.

2655. Diffraction of Light by a Slit. E. T. Hanson. *Optical Soc., Trans.* 31. 5. *pp.* 252–265, 1929–1930.—Next to the problem of the straight edge the simplest and most important problem in diffraction is that of the slit. The former, known as the wedge problem, has been solved. The latter still defies solution. Admittedly the elementary solution of the problem of the slit is sufficient as an explanation of the phenomena commonly observed, but as an exposition of wave theory it leaves much to be desired. An attempt is here made to discuss analytically the theory of the slit as defined below. A slit is a narrow infinitely long opening in an infinitely thin plane screen. The term "narrow" is relative, meaning that the width is small compared with the distance at which the phenomena are observed, but large in comparison with the wave-length of the incident light. The resulting analysis is applicable to points far inside the geometrical shadow, with which the elementary theory cannot cope. AUTHOR.

2656. Measurement of Fibre Diameters by the Diffraction Method. H. J. McNicholas and H. J. Curtis. *Bureau of Standards, J. of Research,* 6. *pp.* 717–734, *April,* 1931. *Rev. Sci. Instruments,* 2. *pp.* 263–286, *May,* 1931.—The classification of wool fibres into standard grades is based entirely on the average diameter of the fibres. The diffraction of light by a bundle of parallel fibres was employed by Young in 1824 in a simple ingenious instrument for the rapid direct measurement of average diameter, but no thorough investigation has ever been made of the practical possibilities of this method in the routine grading of wool. In the present paper a new construction of Young's instrument (the eriometer) is described, and a critical study is made of the accuracy and adaptability of the instrument in the averaging of a wide range of diameters as distributed in a group of fibres. Sources of error and limitations of the method are discussed. It is found that the eriometer average is in excellent agreement with comparable data obtained with the microscope. The method affords considerable opportunity for the further development of instruments to include additional features desirable in the study of wool or other textile fibres. AUTHORS.

2657. Interference Fringes and Rings Formed by Films of Different Refractive Indices. G. Simon. *Rev. d'Optique,* 10. *pp.* 117–130, *March,* 1931.—The apparatus, which is described in detail, is essentially a pair of Fabry and Perot interferometers. In one case the distance between the semi-silvered glass plates is fixed, and in the other is capable of adjustment to distances of the same order as the first. When white light is transmitted through the system, coloured fringes and rings are obtained, which are analysed by a spectroscope. By using a different medium, such as water, for the fixed film, the dispersion throughout the visible spectrum can be studied. The theory of the results is given and is found to be very simple. H. M. B.

2658. Optics of Moving Bodies. A. Sesmat. *Comptes Rendus,* 192. *pp.* 548–551, *March* 2, 1931.—Since radiation is never observed apart from matter, it can be reduced to relations between sources and material receivers. The time of transmission is influenced by the movement of the receiver, but not by that of the source. It is the time required to cover, not the straight line joining the source and receiver, but the "curve of pursuit" directed at any instant towards the actual position of the receiver. The author discusses interference, reflection and refraction on this assumption, and shows that consistent results may be obtained so long as the bodies do not attain the velocity of light. E. E. F. d'A.

2659. Optics of Moving Bodies. V. Lalan. *Comptes Rendus*, 192. *pp*. 614–616, *March* 9, 1931.—Sesmat's hypothesis [see preceding Abstract] involves the conservation of the laws of reflection of moving bodies. The principle of interferences may be formulated as follows. Let there be an assemblage of points P, whose mutual distances are small with respect to λ, and which become secondary sources under the action of a point source. The point receiver R will be illuminated by the point P if the action of P on R is not destroyed by other secondary sources in the immediate neighbourhood of P. E. E. F. d'A.

2660. Refraction and the Curve of Pursuit. V. Lalan. *Comptes Rendus*, 192. *pp*. 933–935, *April* 20, 1931.—On the theory of the curve of pursuit, the result of refraction is the same whatever the motion of the system. The calculation leads exactly to the result already obtained by Einstein. E. E. F. d'A.

2661. Curve of Pursuit and Michelson's Experiment. A. Sesmat. *Comptes Rendus*, 192. *pp*. 1029–1032, *April* 27, 1931.—Shows that on the hypothesis of the curve of pursuit the relative velocities cancel out, and there is no difference in the interference fringes due to orientation. The Michelson experiment should therefore give a negative result. E. E. F. d'A.

2662. Wave and Refraction Treatment of Errors Caused by Coma in an Optical System. J. Picht. *Zeits. f. Instrumentenk.* 51. *pp*. 117–127, *March*, 1931. *Zeits. f. techn. Physik*, 12. 3. *pp*. 182–185, 1931.—The paper supplies a mathematical treatment of the distribution of intensity in a beam of light in which errors are caused by coma. R. S. R.

2663. General Form of the Smith-Helmholtz Equation. T. Smith. *Optical Soc., Trans.* 31. 5. *pp*. 241–248, 1929–1930.—The Smith-Helmholtz equation $\mu \sin \theta y = \mu' \sin \theta' y'$ is only applicable to infinitesimal objects and images. When both field and aperture are large, in addition to the ordinary equation involving lengths measured along a ray, there are three exact equations of the type $xx'a + \mu' L' x' b - \mu L x c - \mu L \mu' L' d = 0$, $bc - ad = 1$, all expressing the same correspondence. This correspondence is primarily geometrical rather than optical. The coefficient a in all these equations is the secondary power of the system for the ray considered. When the instrument is axially symmetrical the coefficients in two of the equations have the values $b = c = 1$, $d = 0$. The third equation can be made to take the same form by moving the origins to suitable points on the axis of the instrument. The equations are considered in their application to asymmetrical instruments. In telescopic systems axial symmetry is, in general, necessary for the Smith-Helmholtz equality to be applicable. From the general equations a great variety of formulæ for computing conjugate points can be obtained. Equations of the same one-one class can be found for other projective relations, but, in general, they are less useful than the corrected Smith-Helmholtz equations, because when the linear and angular variables are associated as desired the positions of the origins must be computed instead of being recognisable by inspection. AUTHOR.

2664. New Test for Cassegrainian and Gregorian Secondary Mirror. J. H. Hindle. *Roy. Astron. Soc., M.N.* 91. *pp.* 592–593, *March,* 1931.—Two diagrams of methods of testing Gregorian secondary mirrors are given. The first is the same as a method adopted by Ritchey for the Cassegrainian. The second is much simpler, and by it the accuracy of the surface of the mirror can be tested to a very small fraction of a wave-length. H. M. B.

2665. Chromatic Method of Making Optical Settings. D. S. Perfect. *Optical Soc., Trans.* 31. 5. *pp.* 249–251, 1929–1930.—The paper describes a visual modification of the author's photoelectric method of measuring small angles [see Abstract 616 (1931)]. Great simplification is introduced by the substitution of visual for photoelectric equipment at the sacrifice of sensitivity. Angular displacements are measured by means of a hollow prism previously described. The settings are made by causing an image of a fine slit to fall on the sharp edge of a steel prism. The two components of the divided beam, after being coloured respectively red and green, are recombined, and a visual method is employed to observe the resulting colour. The relative position of the prism edge and image determines the proportion of red and green and is very sharply defined by the position of best resultant yellow. The settings have average errors of 0·2 sec. and are less fatiguing than cross-wire settings. AUTHOR.

2666. Plane-Parallel Plate Refractometer. A. H. Pfund. *J.O.S.A.*, 21. *pp.* 182–186, *March,* 1931.—A simple refractometer suitable for class experiments is described. It consists of a plane-parallel glass plate, the lower surface of which is coated with white paint. When a brilliant point image is projected on to the glass-paint interface, the image acts as a new source of light, sending out rays in all directions. At angles of emergence greater than the critical angle, the rays are returned to the lower surface and produce an illuminated ring. If a film of liquid is placed on the upper surface, a second ring is obtained. The refractive index of the liquid can be deduced from the plate thickness and ring diameters. The method could be applied advantageously to the measurement of the change in refractive index associated with the " drying " of oils. C. B. A.

2667. Mechanics of the Telescope. E. P. Burrell. *Mechanical Engineering,* 53. *pp.* 255–261, *April,* 1931.—The story of the telescope from the time of Galileo to the present day, the various mechanical problems encountered in the design of a modern astronomical telescope, and the ways in which they have been solved.

2668. Visibility Meter. M. G. Bennett. *Journ. Sci. Instruments,* 8. *pp.* 122–126, *April,* 1931.—A meter is described which measures the degree of clearness with which any particular object can be seen. Very slightly ground glasses are introduced one by one into the field of vision. The number of these glasses, which is just sufficient to obscure the object observed, is the measure of its visibility. Various precautions are adopted which obviate the sources of error found in other instruments of this

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type. Applications to meteorology and illuminating engineering are described. AUTHOR.

2669. Optical Properties of a Lippmann Lenticulated Sheet. H. E. Ives. *J.O.S.A.* 21. *pp.* 171–176, *March*, 1931.—Lippmann in 1908 described a method of obtaining photographs without a camera and showing stereoscopic relief from all directions and distances. A sheet of transparent material embossed with a multitude of small convex lenses was taken, each lens forming a picture on the photographic emulsion at the rear surface. When the sheet is held before the eye and properly oriented and positioned, one sees the object virtually recreated in space. He described two methods of making photographic positive pictures using the lenticulated sheet and considered that true stereoscopic relief resulted. The author criticises this claim and summarises the characteristics of the images when exhibited on the screen. The method of obtaining true stereoscopic relief with this method is explained. R. S. R.

2670. Heterochromatic Photometry. R. Jouaust. *Comptes Rendus*, 192. *pp.* 616–618, *March* 9, 1931.—The luminous intensity of a source of colour temperature T referred to a standard of temperature *t* has no precise physical meaning. It is necessary to choose a curve of visibility factors, as was done by the International Lighting Committee in 1924 in adopting Gibson's curve. E. E. F. d'A.

2671. Limitations of Photometry. A. Blondel. *Comptes Rendus*, 192. *pp.* 782–786, *March* 30, 1931.—The author points out that visual photometry is not a purely objective and physical process, but is subject to the limitations of the physiological characteristics of the eye-brain system, such as persistence of vision, lag of perception, dazzle, etc. The most convenient way of describing the objective result of an illumination system is by means of the lux (unit of illumination), whereas for a system such as a lighthouse the performance should be expressed in terms of its equivalence with a certain candle-power viewed from a distance of 1 km. (or 10 km.). Similarly, if a certain candle-power at a certain distance from the eye can be agreed as representing the threshold of glare, the glaring power of a headlight may be expressed in terms of the distance at which it produces this threshold, which is, of course, a psychological and physiological effect. J. W. T. W.

2672. Differential Ripening. Parts I and II. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 28. *pp.* 350–356, *March, and* 30. *pp.* 7–12, *May*, 1931.—Part I describes attempts at the preparation of emulsions in which grain growth proceeds to an optimum without the simultaneous nuclear formation to any sensible degree. Part II is designed to establish definitely that great excess of bromide is actually the cause of the ripening phenomena previously described, *i.e.* a sixfold increase in gelatin concentration is without observable influence on the grain growth. Microphotographic data have confirmed that without excess of bromide the long known influence of gelatin concentration again occurs. H. H. Ho.

2673. Relation between Darkening, Silver Content, Covering Power, Grain Number and Grain Size of Developed Photographic Films. H. Arens, J. Eggert and E. Heisenberg. *Zeits. f. wiss. Phot.* 28. *pp.* 356–366, *March*, 1931.—Equations are derived connecting darkening with the grain number and size. Nutting's result is confirmed, *viz.* $s = -x \log(1 - ya)$, where x = number of grain layers,

y = number of grains per cm.^{2} of a single layer and a the average projection of the grains per sq. cm. By introduction of the mass μ of the grain, of the amount of silver m (in g.cm.$^{-2}$), of body $\delta = s/m$ (darkening per mg. cm.$^{-2}$) and a form factor f ($f = 1$ for cubes and $\gtrless 1$ for other forms), it is found that $\delta = k\,.\,f/d^{\frac{2}{3}} \times 0{\cdot}435 \times \mu^{-\frac{1}{3}}$ (d = density of the grains). The formulæ are in accord with the experimental development data.

H. H. Ho.

2674. Thermoluminescence Excited by Exposure to Radium. Frances G. Wick. *J.O.S.A.* 21. *pp.* 223–231, *April,* 1931.—Observations were made on (1) $CaSO_4$ mixed with Mn (125 molecules to 1), and (2) specimens of fluorite obtained from different places. For (1) after exposure to Ra a bright-green thermoluminescence results in the band 4800 – 5600 Å., and this is much less intense when subject to pressure, especially for pressures > 5000 kg./cm.^{2} Exposure to light after Ra exposure gives a reduced thermoluminescence on subsequent heating. For (2) exposure to Ra intensifies the bright lines due to the rare earths in the fluorite, but there is little change in the broad band. Increased pressure reduces the thermoluminescence for the rare earths, but the broad band comes out at a lower temperature. With rapid heating the bands due to the several rare earths show up successively. The effect for Ra is similar to that produced by X-rays. [See also Abstract 3321 (1929).

R. S. R.

2675. Propagation of Energy by Waves and the Amplitude of a Light Wave. W. W. Sleator. *J.O.S.A.* 21. *pp.* 187–204, *March,* 1931.—Methods are given for finding the expression for the velocity of plane waves. Waves in a rope, sound waves, and light or electromagnetic waves are discussed. By making use of an advantageous energy relation, the three types of waves are dealt with in precisely similar fashions. J. J. S.

2676. Photographic Measurement of the Wave-Length of Spectral Lines. G. Occhialini. *Accad. Lincei, Atti,* 13. *pp.* 45–46, *Jan.* 4, 1931.—A practical note. H. F. G.

2677. Quantitative Spectrum Analysis. A. Iwamura. *Kyoto Coll. Sci., Mem.* 14. *pp.* 43–54, *March,* 1931.—The gold electrodes of Pollok and Leonard have been modified with the object of rendering the sparking conditions more constant when working with dilute solutions, and methods are described for obtaining conducting solid electrodes from liquid or non-conducting samples. Quantitative measurements with zinc oxide electrodes containing lead show that the reproducibility of the spectrograms lies within the limits $+ 4{\cdot}8\ \%$ and $- 6{\cdot}5\ \%$, and that the limit of sensitivity for the determination of lead is 1×10^{-6}. The spectrographic method of analysis yields results which are somewhat higher than those obtained by purely chemical methods, but its rapidity and simplicity, the absence of personal errors, and the suitability for micro-analysis are noteworthy advantages. H. F. G.

2678. Mass Spectra of Glasses, Salts and Metals by Means of a Circular Mass Spectrograph. H. Murawkin. *Ann. d. Physik,* 8. 4. *pp.* 385–432, *March* 26, 1931.—By means of the circular mass spectrograph previously described [see Abstract 2298 (1931)], spectrograms of glasses containing borates and silicates were investigated for the range of temperature 627° to 1327° C. A strong emission of Na, K, Mg, Ca was found; a considerable emission of Si and O, and a weak irregular emission of heavy metals. Several new oxygen isotopes were registered for the first time. Molecular ions of Na_2, Mg_2, K_2 and Si_2 were shown to be present. Among the doubly charged ions new lines of Si^{++}, Mg^{++} and Ca^{++} were observed. New lines, 38, 42, 43 were also found, which may be interpreted as isotopes of K (in the first two) and Ca (the last). A line 222·2 which has been observed is discussed; it would appear to correspond to the missing element eka-cæsium. The mechanism of emission appears to be due to a simultaneous electrolysis and ionisation by collision. Mass spectrographs of aluminium phosphates, Kunsman's mixture, tungsten, platinum and copper have been obtained. H. L. B.

2679. Infra-Red Absorption Bands in Hydrogen Sulphide. H. H. Nielsen and E. F. Barker. *Phys. Rev.* 37. *pp.* 727–732, *March* 15, 1931.—The absorption spectra of hydrogen sulphide between 1·0 and 10·0 μ contain bands at 2·6 and 3·7 μ, both of which exhibit fine structure. The band at 2·6 μ consists of P and R branches formed of irregularly spaced lines, and an unsymmetrically broadened Q branch; the more prominent lines in the P and R branches are separated by about 10 cm.$^{-1}$, and there is a slight convergence towards the higher frequencies. The band at 3·7 μ consists of only one branch formed of several prominent lines and weaker satellites; the average spacing is about 9 cm.$^{-1}$, and there appears to be no convergence. The results are discussed in terms of Witmer's perturbation method of solution for an asymmetric rotator. The 2·6 μ band results from a vibration of the electric moment along the least axis of inertia, and the 3·7 μ band from a vibration along the intermediate axis. H. F. G.

2680. Near Infra-Red Absorption Bands of Hydrogen Cyanide Gas. R. M. Badger and J. L. Binder. *Phys. Rev.* 37. *pp.* 800–807, *April* 1, 1931.—The absorption spectrum of gaseous hydrogen cyanide has been investigated by photographic methods in the region λ7000–9200. Two weak bands of very simple structure were found, having P and R branches but no Q branches. The band at λ7912 is apparently a harmonic of a fundamental band at 3·04 μ, and the very weak band at λ8563 is a combination band. The hydrogen cyanide molecule is linear in the normal state, and has a moment of inertia $I = 18 \cdot 79 \times 10^{-40}$ gm.cm.^{2}. The distance of separation of the carbon and nitrogen atoms is estimated to be $1 \cdot 15 \times 10^{-8}$ cm. Hydrogen cyanide is discussed in regard to its three fundamental oscillations which have frequencies 3290, 2090 and 710 respectively, and in regard to its dissociation energy and dissociation products. The evidence requires a molecular structure represented by the formula HCN, and shows that the normal molecule is built from a normal hydrogen atom and a normal CN radical. The absorption of cyanogen gas has also been investigated in the photographic infra-red, but no absorption bands could be detected. AUTHORS.

2681. Perturbations and Predissociation in the S_2 Band Spectrum. A. Christy and S. M. Naudé. *Phys. Rev.* 37. *pp.* 903–919, *April* 15, 1931.—The S_2 bands belonging to the ${}^3\Sigma_u^- \longleftrightarrow {}^3\Sigma_g^-$ transition have been photographed with relatively large dispersion in absorption and in emission between λλ3500 and 2400. Several perturbations have been found in the vibrational levels of the excited ${}^3\Sigma_u^-$ state. These became apparent when the quantum assignment of the band heads were determined. The following revised equation was found to fit the unperturbed heads:

$$\nu = 32250{\cdot}9 + 429{\cdot}5(v' + 1/2) - 2{\cdot}75(v' + 1/2)^2 - 727{\cdot}4(v'' + 1/2) + 2{\cdot}91(v'' + 1/2)^2.$$

Weak bands were observed (mainly in absorption) about 20 cm.$^{-1}$ to the violet of the heads in the $v'' = 0$ progression. These bands are believed to be due to another system. Perturbations of about + 17 cm.$^{-1}$ have been found in the heads of the bands with $v' = 0, 2, 4$, which are presumably due to perturbations of the rotational levels near the band heads by another electronic state or perturbations in the U(r) curve of the $^3\Sigma_u^-$ state. Perturbations found in the levels with $v' > 9$ are attributed to a $^3\Pi_u$ state which causes predissociation in these bands. Predissociation is discussed in terms of the Franck-Condon principle of transition probabilities. It is shown that the $^3\Pi_u$ continuous state which causes predissociation must intersect the U(r) curve of the $^3\Sigma_u^-$ state at two points giving the two observed regions of predissociation. The relative transition probabilities for the radiationless jump in the two regions are discussed. The energies of dissociation of the lower and upper states are found to be 4·45 and 2·07 volts. This gives 1·6 volts as the separation of the ^{3}P and ^{1}D states of the S atom. AUTHORS.

2682. Spectrum of Singly Ionised Antimony. D. G. Dhavale. *Roy. Soc., Proc.* 131. *pp.* 109–121, *April,* 1931.—Lines in the first spark spectrum of antimony between 3304 and 8447 Å. are classified, employing the method of horizontal comparison due to Saha and Mazumder. The ionisation potential of Sb+ is approximately 18·8 volts. [See also Abstract 2829 (1930).] J. S. G. T.

2683. Spectrum of Selenium. Part I. SeIV and SeV. K. R. Rao and J. S. Badami. *Roy. Soc., Proc.* 131. *pp.* 154–169, *April,* 1931.—The spectrum from λ7000 to λ650 has been photographed with various grating and prism instruments, including a Siegbahn vacuum spectrograph. The doublet system of SeIV has been identified and a term scheme proposed. The largest term $4p^2P_{\frac{1}{2}} = 346094$ gives an ionisation potential of about 42·72 volts. A few singlets and intercombination lines in SeV have been added to the triplet system discovered by Sawyer and Humphreys. The largest term $4s^1S_0 = 589781$ cm.$^{-1}$ gives an approximate ionisation potential of 72·8 volts. F. S.

2684. Resonance Spectrum of Sulphur Vapour. J. Fridrichson. *Comptes Rendus,* 192. *pp.* 737–739, *March* 23, 1931.—The resonance spectrum of sulphur vapour at various pressures, which could be varied independently of variations of temperature, is studied in a tube containing sulphur vapour and jacketed by the exciting mercury arc. The resonance spectrum extends to 6000 Å. Doublets and multiplets excited by the mercury lines 3132, 3126 and 2968 Å. are tabulated. [See also Abstract 3143 (1930).] J. S. G. T.

2685. Spark Spectra of Mercury. R. Ricard. *Comptes Rendus,* 192. *pp.* 618–620, *March* 9, 1931.—Gives a list of new lines between 4000 and 2700 Å. obtained with an electrodeless discharge. They are identical with the spectra HgI, HgII, HgIII and HgIV. E. E. F. d'A.

2686. Intensity, Broadening, Extinction and Accompanying Background of Mercury Resonance Lines with Addition of Rare Gases. P. Kunze. *Ann. d. Physik,* 8. 4. *pp.* 500–520, *March* 26, 1931.—The influence of the rare gases He, Ne and A on the emission and absorption of Hg 2537 has been studied quantitatively by a photoelectric apparatus. The increase of intensity was determined, and it was shown that the smallest addition of rare gas markedly decreased the absorption. According to the Lorentz theory, the broadening effect of the three rare gases with equal numbers of collisions should be the same, but the experimental results give the ratio for He, Ne and A as 1:1·9:2·7. With pressures of 1 atmosphere of the rare gases the broadenings for He, Ne and A are 18, 12 and 19 mÅ. The intensity integral over the Oldenberg band and the continuous background is negligibly small compared with the intensity of the line. The extinction effect increases in the order He, Ne, A being practically null for He and quite marked for A. J. E.

2687. Energy of Dissociation of Mercury Molecules. J. G. Winans. *Phys. Rev.* 37. *pp.* 897–899; *Disc.*, 899–901, *April* 15, 1931.—The absorption spectrum of mercury vapour in the Schumann region showed three apparently continuous bands with maxima at wave-lengths 1849, 1808 and 1692. The 1849 and 1692 bands appeared without the 1808 band in the emission from an electrodeless discharge through mercury vapour. The absorption spectrum in the region 1900–1804 is correlated with a pair of potential energy curves for Hg_2. From these curves, the energy of dissociation of Hg_2 is 0·15 volts. AUTHOR.

2688. Properties of Some Zinc, Cadmium and Mercury Bands. J. G. Winans. *Phys. Rev.* 37. *p.* 902, *April* 15, 1931.—Zinc bands at wave-lengths 2139, 2064 and 2002 are shown to resemble the corresponding bands of cadmium and mercury in emission as well as in absorption. AUTHOR.

2689. Fine Structure in Mercury Singlet Terms. S. Tolansky. *Roy. Soc., Proc.* 130. *pp.* 558–578, *March* 3, 1931.—A h.f., low-pressure, electrodeless discharge was used in pure mercury vapour, with a 5-ft. pyrex tube, the ends of which were blown into spherical windows. There is no self-absorption in the singlet series in the h.f. discharge, while the triplets are very strongly absorbed. There are no strong electric fields, and bright discharges are obtained with very low pressure. The tube runs quite cold, and very fine lines are obtained. The lines were observed with a Fabry-Perot interferometer. The following structures have been examined: $7^1S_0 - 8^1P_1$, which is found to be a sextet; $7^1S_0 - 9^1P_1$, a septet; $7^3S_1 - 8^1P_1$, an octet; $7^3S_1 - 9^1P_1$, a septet; $6^1P_1 - 8^1S_0$, a quintet; $6^1P_1 - 9^1S_0$, a triplet; $6^1P_1 - 10^1S_0$, a doublet. Information as to the structures of the 7^1S_0, 7^3S_1, 6^1P_1 and 9^1P_1 levels has been obtained. The structures found for ${}^1P_1 \rightleftarrows {}^1S_0$ lines necessitate more than one value of i; to account for the septet character of $7^1S_0 - 8^1P_1$, three values of i may be assumed, one being zero and two greater than $\frac{1}{2}$; the zero value is probably associated with the five even isotopes, the other two with the two odd isotopes (suggestion by Schüler and Brück to account for the fine structure of Cd). H. N. A.

2690. Intensity of Multiplets and Arc Temperature. L. S. Ornstein and S. Sambursky. *K. Akad. Amsterdam, Proc.* 34. 3. *pp.* 339–340, 1931.—A recent paper by Ornstein and Brinkman [see Abstract 1915 (1931)] dealt with the case where the j separation is small and the factor $e^{-E/KT}$ for the levels $j_1, j_2, \ldots$ of a term remains practically constant. The authors now take the j separation as large, of the order of magnitude $\Delta\gamma = 10^3$ cm.$^{-1}$, so that the deviations from the summation rule become considerable. There is then the possibility, by reduction of these relations to the values to be expected theoretically by means of Boltzmann's factor, to draw conclusions as to the temperature of the arc. Details are given as to the relations between certain terms of Au, and a value of about 6000° K. is deduced for the temperature of the arc.

H. N. A.

2691. Test of the Theory of Hyperfine Structure. J. Wulff. *Zeits. f. Physik*, 69. 1–2. *pp.* 70–77, *April* 23, 1931.—The observed hyperfine structures of both the doublet levels of the ground state of thallium do not agree with the theoretical expectations. The separation of the $^2P_{1\frac{1}{2}}$ level should theoretically be $\frac{2}{5}$ of that of the $^2P_{\frac{1}{2}}$ level. Previous measurements for the line λ3775 gave for the separation of the latter level 0·723 cm.$^{-1}$; the measurements here described on line λ5349 show that the first of these two levels has a separation which is so small that it cannot be resolved with the grating employed, and may be about 0·040 cm.$^{-1}$, or about one-seventh of the theoretical value. Measurements on the Zeeman effect confirm this discrepancy.

H. N. A.

2692. Hyperfine Structure as Test of a Linear Wave Equation in the Two-Body Problem. D. R. Inglis. *Phys. Rev.* 37. *pp.* 795–799, *April* 1, 1931.—The proper treatment of the two-body problem is not known. Dirac's relativistic considerations, so successful in the problem of one electron, have been applied by Breit to the two-electron problems. Energy terms appear of which the physical reality is very doubtful. Here a very similar application is made to the problem of a nucleus and an electron, because of the failure of previous treatments of this problem to agree with measurements of hyperfine structure. The doubtful terms do not bring about agreement, so their reality remains improbable. The present state of the theory suggests that the proper interactions have not yet been introduced in the problem of hyperfine structure.

AUTHOR.

2693. Molecular Spectra and Structure of the Molecule. H. Deslandres. *Comptes Rendus*, 192. *pp.* 521–525, *March* 2, 1931.—This is a continuation of previous work [see Abstract 1549 (1931)] linking the empirical constant *d* with the infra-red and Raman values for various gases and crystals.

F. S.

2694. Raman Effect and Electrolytic Dissociation. L. A. Woodward. *Phys. Zeits.* 32. *pp.* 212–214, *March* 1, 1931. *Paper read before the Deut. Phys. Gesell., Dresden, Jan.*, 1931.—The Raman effect has been photographed in solutions in water of nitric acid, sulphuric acid, $KHSO_4$, HCl, iodic acid and trichloracetic acid of different concentrations. The two last named failed to show any marked change on dilution. Nitric acid gave results in agreement with those found by Rao [see Abstract 3905 (1930)] except that the author allocates shifts of 697 and 643 cm.$^{-1}$ to the undissociated acid. Sulphuric acid observations indicated that 1046 cm.$^{-1}$ is due to the HSO_4' ion, and it occurred also in $KHSO_4$; 982 cm.$^{-1}$ belongs to the SO_4'' ion, and it occurs also in solutions of normal sulphates. A frequency near to 900 cm.$^{-1}$ belongs to H_2SO_4. A saturated solution of HCl at 25° C. gave no lines, although the vapour pressure indicates that HCl molecules should be present. Presumably the concentration of HCl is too small to allow an observable Raman effect.

A. C. M.

2695. Raman Effect of OH. L. A. Woodward. *Phys. Zeits.* 32. *pp.* 261–262, *March* 15, 1931.—Concentrated solutions in water of NaOH and KOH give lines at 3615 ± 25 cm.$^{-1}$, which are attributed to the OH ion. In addition a strong continuous spectrum was present. This is compared with 3410 cm.$^{-1}$ given by water, and presumably due to the un-ionised OH group. It is curious that for organic compounds no corresponding frequency is found for the OH group, except 3388 ± 85 cm.$^{-1}$ in the case of methyl alcohol. The frequency of the OH ion is higher than for the OH un-ionised, while the reverse is the case for the CN group.

A. C. M.

2696. Raman Effect and Molecular Association. E. H. L. Meyer. *Phys. Zeits.* 32. *pp.* 293–295, *April* 1, 1931. *Paper read before the Deut. Phys. Gesell., Dresden, Jan.,* 1931.—It is commonly believed that the Raman effect of mixtures is the sum of the effects in the separate constituents, and consequently the effect gives no evidence of molecular association. But few measurements have been made at too little varied concentrations, mostly with mixtures of equal volumes. Measurements of the molecular polarisation show that a 35 % solution of ethyl alcohol in CCl_4 possesses a maximum, interpreted by Debye as due to pairs of alcohol molecules in line, giving double dipole moment. The author has sought for evidence of this in the Raman effect. No result was obtained. In case overlapping of lines was vitiating the conclusions, a repetition was made using methyl alcohol and CCl_4. Still there was no difference in the Raman spectrum. Solutions of copper sulphate showed no evidence of hydration, and yet when ammonia was added, a new band appeared due to the complex ammonia salt. It is concluded that for the Raman effect a definite chemical compound with the same partners is required; that where temporary associations occur no effect is to be anticipated. When two dipole substances are mixed, the case is different, as is shown by photometer curves of methyl-alcohol—water mixtures in different proportions. A line scarcely visible in the pure alcohol gets clearer as more water is added, and shifts about 5 Å. to the violet. The same holds for the 4696 Å. water band as more NO_3 ions are added. A. C. M.

2697. Effect of Combined Electric and Magnetic Fields on the Helium Spectrum. Part II. J. S. Foster. *Roy. Soc., Proc.* 131. *pp.* 133–146, *March,* 1931.—The first part of the paper is an extension of previous work [see Abstract 2188 (1929)], and deals with modifications of the additive law when orthohelium fine structure is studied in the presence of parallel fields. The second part contains descriptions of sources for the study of spectra emitted by atoms in external fields crossed at right angles, and of new effects observed with parhelium and orthohelium lines. The spectrograms were made with a large prism system or with a 30-ft. grating in stigmatic mounting. F. S.

2698. Stark Effect in Molecular Hydrogen in the Range 4100 to 4770 A. J. K. L. MacDonald. *Roy. Soc., Proc.* 131. *pp.* 146–154, *April,* 1931.—In this continuation of previous work [see Abstract 2190 (1929)], certain complex structures exported by Kiuti are resolved into independent lines. Displacements of line components are measured and the observations discussed from a theoretical point of view. F. S.

2699. Synchronous Film Drum for Periodic Spectra. D. C. Stockbarger and C. G. Selig. *Rev. Sci. Instruments,* 2. *pp.* 211–216, *April,* 1931.—A rotating drum, carrying film, is mounted in place of the plate-holder on a quartz spectrograph and is driven by means of a synchronous motor operated by the same current as the light source. The height of the slit is reduced to about ½ mm. For intense sources this method is superior to the use of a driven shutter in front of the slit. It is well adapted to the study of the excitation of traces of foreign gases, the effect of impurities on the rate of recombination of ions, effect of excitation on the appearance of forbidden lines, short-lived phosphorescence phenomena and high-density flash spectra produced by condenser discharges. F. S.

2700. X-Ray Spectrograph for Wave-Length Determination in Air. S. Zeidenfeld. *Rev. Sci. Instruments*, 2. *pp.* 153–163, *March*, 1931.—The instrument consists essentially of a Bragg spectrograph of compact form. A tripod base carries the slit system, crystal table with clockwork motor and curved film-holder. Between the reflecting surface of the crystal and the photographic film is a slit in a lead screen, so geared that the slit permits the true reflected beam to pass, but the lead stops much of the scattered radiation. It is also shown that the principal error in interpolating wave-lengths is that due to inaccuracy of measurement of the photographs. G. E. B.

2701. Absorption of X-Rays. J. Fischer. *Ann. d. Physik*, 8. 7. *pp.* 821–850, *April* 1, 1931.—A mathematical treatment of the absorption of X-rays in which the approximations made in previous investigations have been avoided. The theoretical values obtained show a more satisfactory agreement with experiment than those from the earlier methods. C. B. A.

2702. Influence of Chemical Combination on X-Ray Absorption Spectra. R. Swinne. *Wiss. Veröff. a. d. Siemens-Konzern*, 10. 2. *pp.* 89–94, 1931.—On the basis of London's theory of unpolar combination, arrangements of the peripheral electrons and X-ray terms of certain elements are to be expected in their unpolar compounds which are not found in the polar compounds or in the neutral free atom. This consequence is applied to the qualitative explanation of the peculiarities found by Meyer [see following Abstract] in the K-absorptions of the elements of atomic number above that of iron. The special case of rhombic sulphur is attributed to a strong association of this form of the element. The paper contains an extensive bibliography. C. B. A.

2703. Fine Structure of Absorption Edges of the K-Series of Elements of Medium Atomic Number. H. T. Meyer. *Wiss. Veröff. a. d. Siemens-Konzern*, 10. 2. *pp.* 95–98, 1931.—Fine structure of X-ray absorption edges occurs primarily with elements with variable valency, and then in the higher valency states. Well-developed structure is found in the absorption edges of the elements preceding Kr (Br, Se and As), in the form of bromates (pentavalent), selenates (hexavalent) and arsenates (pentavalent). Monovalent Br (sodium and potassium bromides) shows no fine structure. It is also absent from the spectra of compounds of the mono- and divalent elements following Kr (Rb and Sr), but appears again in quadrivalently-bound zirconium oxychloride, and in pentavalent Nb and hexavalent Mo compounds. C. B. A.

2704. Relation between the K Absorption Edge and the $K\beta_2$ Line of Ni, Cu and Zn. S. Kawata. *Kyoto Coll. Sci., Mem.* 14. *pp.* 55–57, *March*, 1931.—The relation between the K absorption limit and the K_{β_2} line was investigated for the elements Ni, Cu and Zn by the method of comparison to elucidate the process by which X-rays are absorbed. For Zn and Ni the K limit is on the shorter wave-length side of the K_{β_2} line by the amount of 3·0 volts and 2·0 volts respectively, while in the case of Cu the K limit and the K_{β_2} line are just coincident. The result is compared with that which has been reported recently by Kievit and Lindsay [see Abstract 510 (1931)]. AUTHOR.

2705. X-Ray Diffraction of Solid and Liquid Organic Substances. S. Tanaka, G. Okuno and A. Tsuji. *Kyoto Coll. Sci., Mem.* 14. *pp.* 67–71, *March*, 1931.—Powder patterns were compared with liquid patterns obtained from five organic substances. The results are as follows: (1) Corresponding to the intense lines in the crystal patterns, there appear liquid bands; (2) if these crystal lines keep at moderate distances from one another, we get separate liquid bands corresponding to each of them; (3) if these crystal lines lie close together, corresponding to them we get a broad and diffuse band in the liquid state. From these characters it may be concluded that the crystal planes which produce the intense reflection seem to maintain their properties when the crystal becomes liquid. AUTHORS.

2706. Abnormalities in X-Ray Diffraction Patterns of Mixtures. R. W. Drier. *Phys. Rev.* 37. *pp.* 712–714, *March* 15, 1931.—Abnormalities in X-ray spectra of mechanical mixtures of minerals are described. The spectra of some show the presence of extra lines, and in the spectra of others some lines peculiar to the components are missing. Some possible reasons are briefly considered. AUTHOR.

2707. Scattering of X-Rays by Metals. A. Rusterholz. *Helv. Phys. Acta,* 4. 2. *pp.* 68–121, 1931.—From the Debye-Scherrer hypothesis the atomic scattering functions of Al, Cu, Ag, Au and Pt were determined. The proportions of absorption in the preparation were accurately found. The scattering function obtained for Al agrees with Hartree's calculations based on quantum mechanics, and those got for Cu agree with Armstrong's measurements. The scattering functions of Ag, Au and Pt may be accurately calculated according to the Thomas-Fermi relation. J. J. S.

2708. Scattering of Unpolarised X-Rays. G. E. M. Jauncey and G. G. Harvey. *Phys. Rev.* 37. *pp.* 698–711, *March* 15, 1931.—Unpolarised X-rays were scattered by paraffin at angles of 75°, 97° 30′ and 120°, and the results expressed as ratios of the ionisation currents produced at the higher angles to that at the lowest. The wave-lengths and intensities of the X-rays were measured by absorption in aluminium, the same ionisation chambers being used as for the scattering experiments. The theoretical values of the ratios were then calculated from the scattering formulæ of Dirac and of Compton, the former giving excellent agreement with the experimental values. At the wave-lengths used (0·2–0·5 Å.) the difference between the formulæ of Dirac and of Klein and Nishina is so small that experimental discrimination between them is impossible. C. B. A.

2709. Scattering of X-Rays from Gases. E. O. Wollan. *Phys. Rev.* 37. *pp.* 862–872, *April* 15, 1931.—Measurement of the intensity of scattering of X-rays by various gases has been made for scattering angles between 10° and 90°. Soller slits were used to get a well-defined scattering angle and matched filters of ZrO_2 and SrO were used to isolate the K_a lines of molybdenum. Intensity measurements have been made for hydrogen, helium, oxygen, neon and argon. All the measurements were put on the same scale by comparison of the intensity of scattering from the various gases with the scattering from hydrogen at 90°. This is equivalent to putting the intensities on an absolute scale since the scattering from hydrogen at 90° can be calculated with considerable certainty. Values of the structure factors for neon and argon were calculated and comparison made with those determined from wave mechanics for similar atoms. AUTHOR.

2710. Strongly Radiating X-Ray Tube for Excitation of Secondary X-Rays. E. Alexander and A. Faessler. *Zeits. f. Physik,* 68. 3-4. *pp.* 260-266, *March* 20, 1931.—A new design of tube with a water-cooled secondary radiator and with a hot kathode, an antikathode and radiator which can easily be removed and replaced in the same places. It gives twice the intensity of previously-described tubes of similar types. Another tube is described in which the radiator is outside the high vacuum. J. E.

2711. Production of X-Rays Without Tube Focus. G. Reboul. *J. de Physique et le Radium,* 2. *pp.* 86-100, *March,* 1931.—It has been observed that a photographic film wrapped in black paper is blackened when the paper is traversed by an electric current at a voltage of some hundreds of volts. In the present paper it is shown that the effect is probably due to a very absorbable radiation emitted by the film during the passage of the current. Measurements of the absorption of the radiation in air and celluloid lead to the conclusion that the radiation consists largely of X-rays of wave-lengths of several tens of Ångström units. The effect may also be found when an electric current traverses certain substances of high resistance. G. E. B.

2712. Radiation from Metals Bombarded by Low-Speed Electrons. F. L. Mohler and C. Boeckner. *Bureau of Standards, J. of Research,* 6. *pp.* 673-681, *April,* 1931.—A small probe surface at a positive potential in a discharge may draw a current of many amperes per $cm.^2$ with the potential gradient limited to a thin sheath over the surface. Under such conditions a continuous spectrum is emitted by metal surfaces in cæsium, potassium and helium discharges. With a copper probe at 7 volts in cæsium vapour, the intensity $J(\lambda)$ remains of the same magnitude between 6200 and 2400 Å. with a minimum at 5800 and a maximum at 3800 Å. Below 4 volts the spectrum has a high-frequency limit in this range (3000 Å. for copper at 2·15 volts). On the assumption that this is analogous to a continuous X-ray spectrum, observed limits indicate work functions of 1·95 volts for Cu, 2·1 for Ag, 1·45 for W (all in cæsium vapour). The absolute intensity (except for Ag) agrees, within a factor of 2, with values computed from the theoretical equation for the intensity of the continuous X-ray spectrum. The efficiency for Cu at 7 volts is estimated as 5×10^{-7}. A comparison with the published data on the photoelectric effect of the radiation from the electron bombardment of metals indicates that the magnitude of the effects below 10 volts can be explained by this continuous spectrum. AUTHORS.

RADIOACTIVITY.

2713. Coloration of Glass, Quartz and Amethyst by Radiation. J. Hoffmann. *Akad. Wiss. Wien, Ber.* 140. *2a.* 1–2 *pp.* 11–26, 1931.—Pieces of old glass from different buildings and elsewhere, which appeared to have been coloured by sunlight, were analysed. They all contained iron and manganese. Some of them were discoloured by heating, but regained their colour when light from a quartz mercury lamp was passed through them; β- and γ-rays also affected the colour. A number of silicate glasses were investigated, which had been coloured by radium radiation. They were analysed chemically, and details are given of the various tints observed. The effect of pressure on the colour was observed. The fact that all glasses which have a violet tint after irradiation contain manganese, while other glasses containing this element remain colourless, is explained by differences in the manganese compounds concerned. Glasses coloured by manganese (II) ions are yellow, those coloured by manganese (III) ions are violet. It has been shown that the violet colour produced in quartz glass by β- and γ-rays is not due to manganese. It appears to be due to small quantities of iron, possibly with the addition of titanium or of zirconium. H. N. A.

2714. Distribution Figures of Active Deposit on Electrodes. S. Rosenblum and M. Valladares. *Comptes Rendus,* 192. *pp.* 939–940, *April* 20, 1931.—The electrodes were metal plates forming regular polygons, and were placed in hollow metal cylinders containing a strong preparation of radiothorium. The potentials of the electrode and the cylinder were different. The electrode remained in the mixture of strongly ionised air and thoron, at atmospheric pressure, for from 10 to 30 min. The activated electrodes were placed for 1 to 2 min. on photographic plates, and images were produced which indicated the distribution of the active deposit on them. When the electrode was centred in the cylinder the image resembled a flower, the number of petals being the same as the number of corners. There was no activity at the centre of the electrode. Figures with centred and uncentred electrodes are reproduced in the original paper. They recall certain Lichtenberg figures. H. N. A.

2715. Weak Lines in the Natural β-Ray Spectrum of RaC. C. D. Ellis and H. H. Elliott. *Cambridge Phil. Soc., Proc.* 27. *pp.* 277–279, *April,* 1931.—Explains the difficulties met with in dealing with these faint lines, and how they are got over by taking several photographs and discarding all the lines which appear only on one plate. The authors have satisfied themselves that all the lines they give really exist, and think it unlikely that any lines of similar intensity have been missed. Lines $H\rho$ 6030 and 6932, given in published tables, have not been found, $H\rho$ 7974 and 8313 have estimated intensities 0·08, published value 0·04. Line $H\rho$ 6350 is found to be a doublet, $H\rho$ 6322 and 6385, intensities 0·04. Eight new lines have been found, two of which are marked doubtful; $H\rho$ varies from 5615 (doubtful) to 9068, and the estimated intensity from 0·04 to 0·16. The possible error in the determination of $H\rho$ is at least 1 part in 200, due to the difficulty of seeing the lines. Lines have been looked for above $H\rho$ 10,020. It is probable that there are some faint ones between 10,020 and 11,000, and nearly certain that there is one at 11,350 or 11,400. This agrees with an observation made by P. White. H. N. A.

2716. Upper Limit of Energy in the β-Ray Spectrum of RaE. F. R. Terroux. *Roy. Soc., Proc.* 131. *pp.* 90–100, *April,* 1931.—Investigation of the portion of the RaE spectrum above 3500 $H\rho$ by the cloud expansion method [see Abstract **2223** (1930)] shows no trace of an end-point at 5000 $H\rho$ [see Abstract 3758 (1930)], but that the number of particles gradually decreases as $H\rho$ increases to at least $H\rho$ 12,000 (3×10^6 e.v.). About 15 % of the tracks obtained were above 5000 $H\rho$, *i.e.*, about 4 % of the number for the whole spectrum. The average energy of disintegration is 473,000 V $\pm$ 20 %. The deduction of an end-point at 5000 $H\rho$ from the effective range in paper or aluminium may be due to superposition of two curves representing alternative modes of disintegration. C. A. S.

2717. Internal Absorption of γ-Rays of RaD. E. Stahel. *Zeits. f. Physik,* **68.** 1–2. *pp.* 1–11, *March* 11, 1931.—By counting the secondary β-rays sent out from RaD it is shown that from 100 disintegrating atoms at least 83 of the γ-ray quanta sent out undergo internal absorption. Since it is otherwise known that from 100 disintegrating atoms only about three quanta leave the atom, there results the high internal probability of absorption of 96 to 97 %. Adding the number of γ-quanta absorbed and leaving the atom, it follows that from 100 disintegrating atoms at least 86 γ-quanta are sent out. A discussion of the sources of error shows that very probably this number should be rounded off to 100, so that thus each disintegrating atom sends out one γ-ray quantum. J. J. S.

2718. Extended Cosmic-Ray Ionisation Depth Curve, and Evidence for Atom Building. R. A. Millikan and G. H. Cameron. *Phys. Rev.* 37. *pp.* 235–252, *Feb.* 1, 1931.—Fresh and more reliable ionisation/depth curves have been obtained with an improved apparatus at heights of from 20 to 14,100 ft., and in latitudes of from 34° (Pasadena, Cal.) to 59° N. (Churchill, Manitoba). The facts that the results are independent of the earth's magnetic field, and that the ionisation produced by the cosmic rays is a maximum some way below the top of the atmosphere, showing that the rays cannot have passed through an amount of matter comparable with the thickness of that atmosphere, prove that they must originate in interstellar space, and enter the atmosphere as photons. The curves show four distinct bands, the most marked corresponding quantitatively to the formation of helium from hydrogen, and the other three qualitatively to that of oxygen (with carbon and nitrogen), silicon (with magnesium, aluminium and sulphur), and the iron group, *i.e.*, of the three next most frequently occurring groups of elements therefrom. Further confirmation is obtained of the participation by the nucleus in the absorption of the rays. [See Abstracts 566 (1929), and 3761 (1930).] C. A. S.

HEAT.

2719. Heat Transfer through Building Walls. M. S. van Dusen and J. L. Finck. *Bureau of Standards, J. of Research,* 6. *pp.* 493–522, *March,* 1931.—The heat flow through panels built up of ordinary wall sections has been measured by comparison with a standard panel, for which the transmission is determined by the hot-plate method. The results are analysed so that the thermal resistance of other constructions made from the same or different thicknesses of any of the components can be calculated. The results so calculated are in moderately good agreement with measurements made by other observers using different methods, in cases where such data are available for comparison. J. H. A.

2720. Measurement of Thermal Conductivity. L. Joly. *Comptes Rendus,* 192. *pp.* 797–799, *March* 30, 1931.—The arrangement consists of three adjoining chambers, A, B and C, each 2 m. cube. The wall between A and B is of cement, 75 mm. thick, that between B and C of the material to be tested. Chamber B is maintained at a constant higher temperature, say 60°, and the temperatures in A and C give an indication of the conductivity of the material under test as compared with cement. To determine the conductivity more accurately, in chamber B is placed, with axis horizontal, a cylindrical box open at one end, 40 cm. dia., with double walls and glass wool between them, and a thermometer inside and out. The open end is placed against the wall of the material under examination. Inside the box is an electric heater; the current necessary to maintain the temperature inside the box equal to that outside is a measure of the conductivity across the section of material enclosed by the open end. C. A. S.

2721. Dimensional Analysis applied to the Thermal Conductivity of Liquids. J. F. D. Smith. *Indust. and Engin. Chem.* 23. *pp.* 416–419, *April,* 1931.—Assuming that thermal conductivity of liquids is a function of molecular weight, density, specific heat, viscosity, gas constant, thermal expansion and compressibility, an equation has been derived by dimensional analysis connecting these variables. This equation is: $(kK^{\frac{1}{3}}\lambda^{\frac{1}{3}}z^{\frac{1}{3}})/(c^{\frac{2}{3}}\rho^{\frac{1}{3}}m^{\frac{1}{3}}) = \phi(mc/a)$. By making certain modifications this equation can be simplified, and a graph is shown connecting $k/\sqrt[3]{\rho c}$ with $c/(K^2\lambda^{\frac{1}{3}}m^{\frac{1}{3}}z)$. This graph shows a maximum error in thermal conductivity of 4·5 %. AUTHOR.

2722. Pyrometry and Radiation Properties of Heated Metals. R. Hase. *Phys. Soc., Proc.* 43. *pp.* 212–216, *March* 1, 1931.—Discusses the difficulties of temperature measurement in furnaces and the like, due to such causes as the absorption bands of water and of carbon dioxide, which reduce appreciably the total radiation reaching the measuring pyrometer. From Maxwell's electromagnetic theory, combined with Kirchhoff's law, it appears that the emissivity of a pure metal should equal the square root of its resistivity. This expectation is roughly verified for manganin, platinum, nickel, gold and copper. From this relation follows also the conclusion that the energy density at the maximum of the spectral distribution curve should be proportional to the sixth power of the absolute temperature, a relation put forward by Aschkinass, and found experimentally for platinum by Lummer and Pringsheim; it is now verified for iron and for nickel. J. H. A.

2723. Characteristics of Thermoelectric Radiometers. M. Tanaka. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 298. [65 *pp.*], *July,* 1930. *Long English Summary.*—The characteristics of thermoelectric radiometers of the Rubens and Moll types, and of a type designed by the author, are discussed. Attention is directed chiefly to the error due to the source not being on the central line of the radiometer, to the drift of zero point with change of room-temperature, to the sensitivity, and to the character of the reflector. Eight photographs of the instruments are included. J. H. A.

2724. Apparatus for Evaporation of Materials in High Vacua. C. H. Cartwright and J. Strong. *Rev. Sci. Instruments,* 2. *pp.* 189–193, *March,* 1931.—A convenient form of apparatus for the deposition in high vacuum of most metals and some non-metals on various surfaces. The material to be evaporated is brought in contact with a heating coil or placed in a small crucible electrically heated. In the former case two types of coils are used: a horizontal helical filament for evaporating wires while a vertical helical spiral is convenient for general use. The filament is made of tungsten or platinum and is made by winding the wire around a cylindrical or conical die. The material is placed in the coil and after a vacuum is obtained it is heated to the temperature necessary for evaporation by contact; if the material melts its surface tension prevents it from dropping out of the filament. Materials which react with platinum or tungsten are evaporated in a crucible made from a small piece of magnesia, alumina or graphite fitted into a filament. The apparatus is mounted under a bell jar. The mirror is supported in an inverted position, as this is necessary to ensure a perfect surface. The metallic elements which have been deposited by this method are: Al, Sb, Be, Bi, Ca, Cr, Co, Cu, Au, Fe, Pb, Mg, Mn, Ni, Se, Ag, Te, Sn and Zn. It is possible to evaporate some alloys, for example, speculum metal. Some non-metals which can be deposited are: quartz, fluorite, the alkali halides and silver chloride. A silver surface protected by less than a wave-length of quartz was immune to exposure to hydrogen sulphide. E. G.

2725. Dependence of Properties of Glass on Former Heat Treatment. E. Berger. *Zeits. f. Instrumentenk.* 51. *pp.* 127–136, *March,* 1931.—Density differences, expansion, electrical conductivity, refraction and other properties are influenced by the previous cooling processes undergone by the glass. Experiments on the expansion and on the refractive index of a glass rod with rise of temperature gave a series of points connecting the time of cooling with these quantities for various initial values. These lead to a "statical transformation point," the temperature at which the glass changes from a viscous liquid to the brittle solid. This is shown to be due to changes in the state of aggregation in the glass. The growth of crystals in a metal is similar to the changes in glass. It is concluded that the cooling process has no mechanical connection with the tension in the viscous flow of the glass, as Adams and Williamson assumed, but is dependent solely on internal physico-chemical variations of the state of aggregation. Double refraction of quickly cooled glass is due to displacement of equilibrium in the interior of the glass causing different states of aggregation, differences of density and thus tension. R. S. R.

2726. Application of Bernoulli's Formula to the Expansion of Gases. M. Drzewiecki. *Comptes Rendus*, 192. *pp.* 1024–1026, *April* 27, 1931.—Bernoulli's equation $P = p + \Delta V^2/2g$ is applied to discuss the expansion and glow of gases. Calculated and experimental values of V/W, where V denotes the velocity of the gas and W the translatory velocity acquired by the molecules are found to be in very close agreement. J. S. G. T.

2727. Valve Method of Temperature Control. F. O. Schmitt and O. H. A. Schmitt. *Science*, 73. *pp.* 289–290, *March* 13, 1931.—Methods of controlling the temperature of water-baths, etc., in which the heating current is regulated by a platinum-mercury contact through an electromagnetic relay lead to pitting of the relay contacts and to fouling of the mercury surface owing to the passage of relatively high currents, usually of the order 0·1 ampere. This inconvenience may be obviated by the use of the new thyratron regulator valve, type FG-27, made by the General Electric Company. This is a mercury-vapour valve capable of controlling a peak current of 5 amperes by means of a grid in which a current of less than 0·1 mA may flow. Thus, by inserting the toluene-mercury regulator in the grid circuit of the thyratron unit the current passing across the mercury surface is reduced over a thousandfold. Details of the circuit and its use are given. T. H. P.

2728. Linear Crystallisation of Supercooled Melts and Supercooled Solid Modifications. M. Volmer and M. Marder. *Zeits. f. phys. Chem.* 154. *Abt. A.* 1–2. *pp.* 97–112, *April*, 1931.—The crystallisation velocity of glycerol has been determined as a function of the bath temperature and of the limiting temperature. Two types of theoretical treatment are given, of which the second, based on the assumption that an important part is played by the frequency of formation of new planes of crystallisation, yields a crystallisation velocity-temperature curve which accords, at least theoretically, with the experimental results. H. F. G.

2729. Fusion Curves of Binary Mixtures. R. Kremann. *Zeits. f. phys. Chem.* 154. *Abt. A.* 1–2. *pp.* 136–142, *April*, 1931.—A reply to Puschin and Rikovski [see Abstract 1595 (1931)], reaffirming the author's view. H. F. G.

2730. Simple Method of Measuring Specific Heat of Solids at Ordinary Temperature. Application to Beryllium. P. Vernotte and A. Jeufroy. *Comptes Rendus*, 192. *pp.* 612–614, *March* 9, 1931.—Refers to some errors of the usual simple calorimetry, including the uncertainty as to the temperature at which the charge is inserted into the calorimeter, doubt as to the exact water equivalent of the latter and the possibility of evaporation of water during the experiment. The first difficulty is overcome by taking room temperature as the initial temperature, and having the calorimeter at only 2° or 3° C., which at the same time practically eliminates evaporation errors. A similar experiment with a body of known specific heat is used to determine the water equivalent. The specific heat of beryllium was found to be 0·397 cal. per gm. per 1° C. at 13° C. J. H. A.

2731. Relation between Absolute and Technical Systems of Thermal Measurement. R. Hermann. *Zeits. f. techn. Physik*, 12. 4. *pp.* 213–218, 1931.—The numerical factors for conversion from the absolute

C.G.S. system to the technical system, used in thermal work on the Continent, are set out. This system uses the metre, hour and kilogramme (as unit of force), with the degree Centigrade. The factors to convert the measure of a quantity in the absolute system to its measure in this system are set out below:

Quantity.	Factor.
Velocity	36
Acceleration	$1\cdot29600 \times 10^5$
Specific Gravity	1·01976
Density	$0\cdot78685 \times 10^{-5}$
Specific Gravity (Technical)/Density (Abs.)	1000
Viscosity	$2\cdot83268 \times 10^{-6}$
Kinematic Viscosity	0·36
Specific Heat	One
Specific Heat per Unit Volume	1000
Thermal Conductivity	360
Heat Transmission Coefficient	$3\cdot6 \times 10^4$

J. H. A.

2732. Specific Heat of Methane. P. C. Ludolph. *Phys. Rev.* 37. *pp.* 830–831, *April* 1, 1931.—Two different forms have been suggested for the CH_4 molecule by various authors. They are the symmetrical tetrahedron and the symmetrical pyramid. Calculations have been made for the values of the specific heat at constant volume for the two types of structure. It is found that neither type gives values in agreement with experiment. The curve obtained on the basis of a tetrahedral structure, however, gives much better agreement than the resulting curve for the pyramidal structure. AUTHOR.

2733. Prediction of Critical Temperatures and Heats of Vaporisation. K. M. Watson. *Indust. and Engin. Chem.* 23. *pp.* 360–364, *April*, 1931.—A method is developed for estimating the critical temperature of a non-polar liquid from its boiling point T, molecular weight M, and the liquid density d, the relationship being: $T/T_c = 0\cdot283(M/d)^{0\cdot18}$. The error in the use of this method is in general less than 2 %. By means of the equation $ML/T = 8\cdot75 + 4\cdot571\ (\log_{10} T)$, it is possible to calculate the latent heat of vaporisation of a non-polar liquid at any desired temperature and pressure without experimental determination. The data necessary are the critical temperature and the normal boiling point. The results are in agreement to within less than 5 %, except for small values for latent heats. F. J. B.

2734. Partial Pressures of Vapours of Volatile Liquids in the Presence of Inert Gases. W. G. Beare, G. A. McVicar, and J. B. Ferguson. *J. Phys. Chem.* 35. *pp.* 1068–1073, *April*, 1931. *Paper read before Canad. Chem. Convention, Ottawa, May*, 1930.—The partial pressures of methyl alcohol, ethyl alcohol, acetone, and ether, have been determined in the presence of dry air and dry CO_2. The determinations in air were carried out with liquid samples which were subsequently removed from the all-glass apparatus. The differences between the partial pressures and the vapour pressures were usually less than 1 mm. The large discrepancies previously reported were not observed. H. H. Ho.

2735. Physical Properties of Compressed Gases. Part I. Nitrogen. W. E. Deming and Lola E. Shupe. *Phys. Rev.* 37. *pp.* 638–654, *March* 1, 1931.—The p-v-T relations obtained by Bartlett and others are examined, and the derivatives $(dv/dp)_{\mathrm{T}}$, $(dv/d\mathrm{T})_p$ and $(d^2v/d\mathrm{T}^2)_p$ evaluated by a graphical process which works, not with the whole quantity under consideration, but only with its difference from the value for a perfect gas. Here p, v, T have their usual meaning of pressure, volume, and absolute temperature. By a certain amount of extrapolation, the values are tabulated over the range –70° C. to 600° C. and up to 1200 atmospheres. From the smoothed values, various other quantities are calculated, including the specific heats (taking as basis for values at 1 atmosphere, the results of Brinkworth and of Partington and Shilling). The calculated values of C_p at high pressure agree moderately well with the experimental values due to Krase and Mackey and the cause of the divergencies is discussed. J. H. A.

2736. Constants of Beattie-Bridgeman Equation of State with Bartlett's P-V-T Data on Hydrogen and on 3 : 1 Hydrogen-Nitrogen Mixture. W. E. Deming and Lola E. Shupe. *Am. Chem. Soc., J.* 53. *pp.* 843–849 *and pp.* 860–869, *March,* 1931.—In two previous papers Bartlett and his co-workers [see Abstract 3181 (1930)] have published compressibility data for hydrogen, nitrogen and their 3 : 1 mixture to 1000 atm. press. and from – 70° to 400° C. Their measurements and compilation of data from other sources have been smoothed and averaged and placed in a table showing PV at even temperatures and pressures over that range. The constants in the Beattie-Bridgeman equation of state: $\mathrm{PV}^2 = \mathrm{RT}(\mathrm{V} + \mathrm{B}_0(1 - b/v)(1 - c/\mathrm{VT}^3) - \mathrm{A}_0(1 - a/\mathrm{V})$; are found to be for hydrogen: Below the critical density: $\mathrm{A}_0 = 124040$, $\mathrm{B}_0 = 20\cdot22$, $a = 56\cdot16$, $b = -7\cdot22$, $c = 20 \times 10^6$). Above the critical density: $\mathrm{A}_0 = 124040$, $\mathrm{B}_0 = 17\cdot50$, $a = 56\cdot16$, $b = -19\cdot68$, $c = 20 \times 10^6$). At densities greater than 0·0270 mole per c.c. the calculated pressures are invariably too small and the deviations become quite large. For the 3 : 1 hydrogen-nitrogen mixture ; Below the critical density: $\mathrm{A}_0 = 3000 \times 10^2$, $\mathrm{B}_0 = 25\cdot03$, $a = 21\cdot36$, $b = -15\cdot16$, $c = 16 \times 10^6$. Above the critical density, $\mathrm{A}_0 = 3489 \times 10^2$, $\mathrm{B}_0 = 21\cdot42$, $a = 28\cdot56$, $b = -30\cdot58$, $c = 16 \times 10^6$ [see Abstract 3182 (1930)] for the nitrogen data. H. H. Ho.

2737. P-V-T Data for Ammonia to 1000 Atmospheres from 30° to 200° C. F. G. Keyes. *Am. Chem. Soc., J.* 53. *pp.* 965–967, *March,* 1931.—Two tables of data are given showing pv values at the actual temperatures observed for volumes from 1·50 cc./gm. to 6 cc./gm. and for even pressures from 100 to 1100 atmospheres and for each ten degrees of temperature to 200° C. H. H. Ho.

2738. Thermodynamic Properties of Dichlorodifluormethane, a New Refrigerant. R. M. Buffington, W. K. Gilkey, M. E. Bixler, F. W. Gerard, and F. R. Bichowsky. *Indust. and Engin. Chem.* 23. *pp.* 254–256, *March, and pp.* 364–367, *April,* 1931.—A series of determinations and computations of the thermodynamic properties of dichlorodifluormethane were made. The constants of the Beattie-Bridgeman equation of state for the superheated vapour were determined from measurements of isometrics between volumes of 1·4 and 4·21 per mol.

In this region the isometrics were straight. The final equation was: $p = \mathrm{RT}(\mathrm{V} + \mathrm{B})/\mathrm{V}^2 - \mathrm{A}/\mathrm{V}^2$, where $\mathrm{A} = 23\cdot7(1 - 0\cdot305/\mathrm{V})$, and $\mathrm{B} = 0\cdot59(1 - 0\cdot622/\mathrm{V})$. Determinations of the vapour pressures of dichlorodifluormethane were made by a static method from − 70° C., to the critical temperature, 111·5° C. The calculated normal boiling point was found to be − 29·8° C., the Trouton and Hildebrand constants were calculated to be 20·0 and 27·1 respectively. The vapour pressures were shown to agree with the equation: $\log p = 31\cdot6315 - 1816\cdot5/\mathrm{T} - 10\cdot859 \log \mathrm{T} + 0\cdot007175\mathrm{T}$, where p is the pressure in absolute atmospheres. The orthobaric densities were measured up to the critical temperature and the critical constants were determined. The critical temperature was found to be 111·5° C., the critical pressure, 39·56 atmospheres, and the critical density, 0·555 gm. per c.c. F. J. B.

2739. Equation of State of Helium. J. G. Kirkwood and F. G. Keyes. *Phys. Rev.* 37. *pp.* 832–840, *April* 1, 1931.—A brief review of the statistical theory of the equation of state is presented. Upon the basis of a recent quantum mechanical calculation of the interatomic energy, the second virial coefficient of helium has been calculated. With the use of the theoretically determined virial coefficient some properties of helium have been computed. A detailed comparison with experimental data is given. AUTHORS.

2740. Integer Relations in Molecular Heats of Gases and Critical Constants. M. Trautz. *Ann. d. Physik*, 8. 4. *pp.* 433–455, *March* 26, 1931.—A number of relations are empirically obtained and examined. J. H. A.

2741. Relativity of Kinetic Energy and of Absolute Temperature. G. Rabbeno. *Elettrotecnica*, 18. *pp.* 175–177, *March* 15, 1931.—When any kind of energy is transformed into kinetic it loses its scalar nature and becomes vectorial and relative to the system of reference. Thus for every variation of potential energy the flow of energy from one material mass to another for the repartition of the whole between the parts varies according to the system of reference. So "absolute" temperature defined as thermal level of a mass in relative motion varies according to the system of reference. Since work cannot take place without relative displacements the relativity of flows of energy is a very general characteristic which must be put at the base of measurements of energy in all physical phenomena. J. J. S.

2742. Variation with Temperature and Volume of the Quantities "a" and "b" in van der Waals' Equation. Parts I and II. J. J. van Laar. *K. Akad. Amsterdam, Proc.* 34. 2. *pp.* 227–238, *and* 34. 3. *pp.* 346–360, 1931. *In German.*—Part I. Owing to the variation with temperature and pressure of the quantities a and b in the equation $\left(p + \frac{a}{v^2}\right)(v - b) = \mathrm{RT}$, the constant-volume lines are not rectilinear. Nothing, however, can be deduced as to the separate variations of a and b. From recent work on hydrogen, the constant B in the empirical equation $pv = \mathrm{A} + \frac{\mathrm{B}}{b} + \frac{\mathrm{C}}{v_2}$, etc., is found to be a function of the temperature, thus: $10^6\mathrm{B} = 940\mathrm{RT} - 320 - 19\cdot5/\mathrm{RT}$. Now $\mathrm{B} = \mathrm{RT}b_g - a_g$, where b_g and a_g are the values of b and a when the volume is very great, and approximate formulæ are assumed for *b* and *a* separately, so as to satisfy this equation for B. An attempt is then made to work out a formula for the variation of *b*; but it is found that the resulting equation contains only limiting values of *b* and is therefore independent of any variation.

Part II. With the aid of the law of rectilinear diameters, and of the vapour pressure equation, it is possible to deduce values of *a* and *b* at the critical point, and when *p* and T are both zero. Combining these values with those dealt with in Part I, approximate formulæ are proposed for the variations of *b* and *a* with temperature, *viz.*: $10^6 b_g = 940 + 75/RT$; $10^6 A_g = 395 + 19\cdot5/RT$. The variations of *a* and *b* along an isothermal are next considered, the equation of state being written in two new forms, suitable for the present calculations. Upon comparison with the experimental results of Amagat and of Bridgman, the author's formula for the variation of *a* and *b*, is found to be valid, except at very high pressures. Diagrams of the suggested variation of *a* and *b* are given. J. P. A.

2743. Nuclear Spin and the Third Law of Thermodynamics. Entropy of Iodine. W. F. Giauque. *Am. Chem. Soc., J.* 53. *pp.* 507–514, *Feb.,* 1931.—The heat capacity, vapour pressure and spectroscopic data on iodine have been used to obtain accurate values for its heat of sublimation and entropy. The heat of sublimation was found to be 15,640 cal./mol. at absolute zero and 14,877 cal./mol. at 298·1° K. With the assistance of the spectroscopic data an equation for the solid vapour pressure has been obtained:

$$\mathrm{Log}_{10}\,\mathrm{P\ (atm.)} = -\,3512\cdot3/\mathrm{T} - 2\cdot013\,\log_{10}\mathrm{T} + 13\cdot347.$$

$$\mathrm{S}298\cdot1,\ \mathrm{I}_2(\mathrm{S}) = 27\cdot9 \pm 0\cdot1\ \text{cal./deg. per mol.}$$

$$\mathrm{S}298\cdot1,\ \mathrm{I}_2(g) = 62\cdot29\ \text{cal./deg. per mol.}$$

These quantities are not the absolute entropies of iodine, but are less by the amount of entropy due to nuclear spin, which is unknown. The values given can be used in combination with other such values to obtain entropy changes accompanying chemical changes. It has been determined that the limiting high-temperature entropy effect due to nuclear spin persists to temperatures below 10° K. This is important, since, if, as expected, this characteristic proves to be general except for H, it will greatly simplify the complications introduced by nuclear spin in connection with the application of the third law of thermodynamics. J. E.

2744. Entropy, Elastic Strain and the Second Law of Thermodynamics; the Principles of Least Work and of Maximum Probability. W. S. Kimball. *J. Phys. Chem.* 35. *pp.* 611–623, *Feb.,* 1931.—By extending the meanings of force and strain, a relation between entropy and total strain is established. The equilibrium state of a gas is then interpreted as a kind of mechanical equilibrium. J. H. A.

2745. Joule's Experiment on the Mechanical Equivalent of Heat. C. Camichel and L. Escande. *Comptes Rendus,* 192. *pp.* 825–828, *April* 7, 1931.—A consideration of Joule's experiment in stirring water from the point of view of hydraulics. It is pointed out that the turbulent flow obtained accounts for the constant rate of energy dissipation at constant speed. Had conditions been otherwise, the marked diminution of viscosity between the initial and final temperatures of the experiment (10° and 50° C.) would have resulted in a decrease in the power absorbed as the experiment progressed. J. H. A.

SOUND.

2746. Longitudinal Vibration of a Loaded Rod. B. R. Hubbard. *Acoustical Soc. of America, J.* 2. *pp.* 372–383, *Jan.*, 1931.—Gives equations for finding the natural frequency of a free, loaded rod and a clamped, loaded rod. Owing to the fact that the relative amplitudes are inversely proportional to the masses, the unequally loaded rod may be used as an acoustic lever for the transformation of amplitudes. This principle has been most effectively used in the design of submarine oscillators. E. E. F. d'A.

2747. Production by Means of an Air-Jet of Acoustic Waves of Velocity Exceeding that of Sound. J. Hartmann. *Phil. Mag.* 11. *pp.* 926–948, *April,* 1931.—The material published in previous papers [see Abstract 1823 (1927)] is dealt with in fuller detail. With an air-jet oscillator, or small cylindrical cavity, in the path of the jet, oscillations may be obtained with frequencies up to about 400,000 ∼ per sec. when hydrogen gas is employed. Also the power of the sound wave may attain a value of several kW. With an air-jet pulsator the period is longer the greater the volume of the pulsator and the narrower its aperture, and pulsations may be produced with a frequency of 1 in many minutes. The rationale of the pulsation process is described and illustrated. G. E. A.

2748. Velocity of Sound in Helium Gas at Temperatures Obtained with Liquid Helium. W. H. Keesom and A. van Itterbeek. *K. Akad. Amsterdam, Proc.* 34. 2. *pp.* 204–209, 1931. *Comm. No.* 213*b from the Phys. Lab., Leiden.*—Measurements of the speed of sound were made by Thiesen's method [see Abstract 828 (1908)] at temperatures 4·245° and 3·873° K. for pressures between 65 and 5 cm. of mercury. Graphs of the $(\text{speed})^2$ at these temperatures show that the speed increases with diminution of pressure, and by extrapolation the speeds at zero pressure are found, *viz.*, 121·4 and 116·4 m./sec. respectively. The corresponding values for C_p/C_v are 1·669 and 1·682. [See also Abstract 3773 (1930).] G. E. A.

2749. Velocity of Sound in Solutions of Alkali Halides and their Compressibilities. E. B. Freyer. *Am. Chem. Soc., J.* 53. *pp.* 1313–1320, *April,* 1931.—The work of Part I [see Abstract 2539 (1929)] is now continued, the velocity of sound in solutions of iodides, chlorides and bromides of sodium and potassium having been measured, using high frequencies and a resonance method of detecting nodes. The data cover nearly the entire concentration range for the various salts, and the temperature range 15° to 45° C. It is shown that addition of salt lowers the adiabatic compressibility of the solutions, the lowering being quite different for equal percentages of the different salts, and much more nearly equal for equal molalities. In the latter case, the lowering is shown to be related to the contraction of the solvents and hence, presumably, to the hydration produced by the ions. H. H. Ho.

2750. Acoustical Investigations of Musical Instruments. Part III. The Tudumi. J. Obata and Y. Ozawa. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 93–105, *March,* 1931. *In English.*—The tudumi is a kind of drum with a dumb-bell-shaped body. The paper contains the results of investigations on the tone-colour of the two kinds of the tudumi *viz.*, the kotudumi and ôkawa. The sounds were recorded, as in previous work [see Abstract 1979 (1931)], by means of a condenser microphone and oscillograph. Generally speaking, the sound of the kotudumi contains, besides the fundamental, a partial tone having a frequency slightly smaller than thrice that of the fundamental. Among the four kinds of tone—*ta*, *ti*, *pu* and *po*—produced by the kotudumi or shoulder drum, the pitch of the first two is in the neighbourhood of 300 or d^1, while the other two are about one full tone lower. The *po* tone is the most characteristic, the tension of the membrane being removed immediately after a stroke, and it is found that the pitch is lowered about one full tone within 0·15 sec. after the stroke. The sound of the ôkawa or side-drum is found to be comparatively simple, consisting mainly of a tone having a pitch of about 650; the tone being therefore about one octave higher than the *ta* and *ti* of the kotudumi. Its duration is very short, the amplitude decreasing to a half value within 0·02 sec.

AUTHORS.

2751. Effect of a Direct Current on the Frequency of a Sonometer Wire. R. Schaffert. *Rev. Sci. Instruments*, 2. *pp.* 231–236, *April*, 1931.—Gogate and Naik (*Nature*, 125. p. 819, May 31, 1930) described an experiment showing that a vibrating sonometer undergoes a lowering in frequency when placed in a d.c. circuit. In the present paper it is shown that this effect is purely thermal. As the wire expands and moves over the bridge its motion is opposed by the friction of the bridge so that the slack of the wire is not entirely taken up by the weight. The tension of the vibrating portion is thus reduced, and consequently the frequency is lowered.

G. E. B.

2752. Science of the Voice. D. Stanley. *Frank. Inst., J.*, 211. *pp.* 405–455, *April*, 1931.—The author has, in collaboration with other scientists, investigated the subject of vocal technique. The results of their researches have destroyed practically every theory held by vocal teachers all over the world, and have set up an entirely different set of principles. The idea that a great voice is the result of certain anatomical gifts and peculiarities is totally fallacious. In singing the breath escapes very slowly when the technique is good. There is minimum breath expulsion with *mf* intensity, and maximum when the intensity is pianissimo. When the tone is badly produced and throaty, breath expulsion increases as the intensity increases. The idea of breath control is wrong, and for this the proper substitute is the vibrato, in which the intensity fluctuates about six times a second with an accompanying slight fluctuation of pitch. Both sexes have two registers, the lower or chest voice and the upper or head voice, or falsetto. The first step in training should be the isolation of the two registers, and all speech must be in the lower register. The range of every properly produced voice should be at least three octaves, and sometimes nearly four may be reached. Incorrect resonance adjustment very often cuts off from five tones to an octave from the top of any voice. The resonating cavities are illustrated, and some of these are adjustable. When the technique is good, the mouth is not used as an important resonator: this function belongs properly to the pharyngeal cavities. Under muscular tone the actions of the constrictor and extensor muscles which govern the laryngeal pharynx are described. To attain their proper use the beginner should sing very vigorously. The *coup de glotte* is condemned as leading only to throatiness. Lines of further research are suggested. G. E. A.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

2753. Theory of Dielectrics. G. Guében. *Phil. Mag.* 11. *pp.* 405–410, *Feb., and pp.* 995–996, *April,* 1931.—The assumption is made that the current in a dielectric is due both to the contribution of dipoles and to the presence of ions, and, from a determination of the amount due to each, a formula has been derived for the general expression of the current in a solid dielectric, *viz.*: $\mathrm{I}_{\propto} = q\epsilon(u + v)\mathrm{HZ}/[la' + \mathrm{H}(u + v)]$, where I = finally steady current, ϵ = electronic charge, u and v = ionic mobilities, H = electric field, l = thickness of dielectric, and q and a' are constants in the law of recombination of ions, $dn/dt = q - a'n$. **J. H. J. Poole** points out that in general the conductivity of a dielectric when exposed to intense electric fields is given by the established formula, $\log \mathrm{K} = \mathrm{A} + \mathrm{BH}$, where K is the conductivity and A and B constants, a result incompatible with Guében's formula, since the value of K deduced from it will decrease with increase of H instead of increasing, as is shown by experiment. A possible explanation of the discrepancy is that both metallic and electrolytic conduction may occur in a dielectric. H. H. Ho.

2754. Measurement of Dielectric Constants of Aqueous Electrolytes by the Ellipsoid Method. O. Milicka and A. Slama. *Ann. d. Physik,* 8. 6. *pp.* 663–701, *March* 23, 1931.—The dielectric constants of various electrolytes were measured by Fürth's ellipsoid method, which consists in measurement of the angle of deflection of a conducting ellipsoidal body suspended by a thin thread between the vertical plates of a condenser filled with the investigated liquid when an electric field is produced between the plates. An apparent dependence of the constant on the tension applied to the plates has been shown to be due to polarisation at the metal ellipsoid used and is not real. Measurements were made with NaCl solutions of various concentrations with tensions between 10 and 25 volts and frequencies between 277 and 2212 per sec., which were produced with a glow-kathode generator and showed no deviations from the measurements with 50 per sec., indicating the independence of the constant on frequency in this region. A ballistic method of measurement is described. Numerous measurements by static and ballistic methods gave results in agreement and indicated that no systematic falsification through heat convection currents took place. Results are given of the measurements of the dielectric constants with solutions in water of the following electrolytes: NaI, NaBr, NaCl, $CuCl_2$, $BaCl_2$, $AlCl_3$, $PbCl_2$, $FeCl_2$, $FeCl_3$, $NaNO_3$, $Ba(NO_3)_2$, HCl, HNO_3, H_2SO_4, H_3PO_4, H_3BO_3, NaOH, KOH, $Ca(OH)_2$. The curves of the dielectric constant as function of the concentration show that the constant at very small concentrations decreases with increasing concentration; at greater concentrations it increases with rising concentration. One or two minima or inflection points were observed. For very great concentrations the dielectric constants seem to approach saturation values which are mostly higher than the dielectric constant of water. The initial decrease of the constant is explained by the formation of hydration spheres around the ions, and the extreme and inflection points by the formation of complexes between the ions. J. J. S.

2755. Dielectric Constant of Hydrogen Chloride from 85° to 165° K. R. M. Cone, G. H. Denison and J. D. Kemp. *Am. Chem. Soc., J.* 53. *pp.* 1278–1282, *April,* 1931.—The dielectric constant of solid hydrogen chloride has been measured from 85° K. to the melting point, and that of the liquid from the melting point to 165° K. The molal dielectric susceptibility and polarisability have been computed. At 98·4° K., the transition temperature, the dielectric constant changes isothermally from 3 to 10, a behaviour which is in accord with Pauling's theory of the rotation of molecules in crystals. H. H. Ho.

2756. Influence of Dispersed Colloids on the Sparking Potential of Insulating Liquids. P. Böning. *Zeits. f. techn. Physik,* 12. 4. *pp.* 200–202, 1931.—This paper continues previous work [see Abstract 2821 (1928)] on the influence of charged particles on the sparking potential of fluids, by measuring the effect of colloidal additions upon certain oils. The effect observed is ascribed to the electric charges associated with the dispersed particles. H. H. Ho.

2757. Free Rotation and Temperature Dependence of Molecular Polarisation. L. Meyer. *Phys. Zeits.* 32. *pp.* 260–261, *March* 15, 1931.—Sänger [see Abstract 1990 (1931)] concluded that 1:2-dichloroethane did not possess a temperature-dependent moment and described the author's result as an association effect. It is now emphatically argued that 1 : 2-dichloroethane cannot exhibit strong association on: (*a*) experimental grounds; (*b*) the linear character of molecular polarisation with respect to reciprocal temperature; (*c*) the exact temperature relationship of molecular polarisation. H. H. Ho.

2758. X-Ray Studies of Motions of Molecules in Dielectrics under Electric Stress. R. D. Bennett. *Frank. Inst., J.* 211. *pp.* 481–487, *April,* 1931.—This paper describes a continuation of previous work on the search for the source of dielectric polarisation [see Abstracts 3473 and 4072 (1930)] in which an X-ray investigation has been made of motions brought about in a dielectric when it changes from liquid to solid under electric stress. Ewing has shown that a mixture of waxes under these conditions shows an isotropic scattering power for X-rays, and similar experiments are now recorded for paraffins. The material used had a fairly definite melting point and X-ray measurements indicate that it consisted chiefly of molecules $C_{27}H_{56}$. The conclusion is drawn that the molecular group state of the liquid is accentuated as the liquid solidifies, leading to definite crystalline structure, which can be strongly oriented by the electric field. H. H. Ho.

2759. Electric Moment and Molecular Structure. Part III. Double and Triple Bonds and Polarity in Aromatic Hydrocarbons. C. P. Smyth and R. W. Dornte. *Am. Chem. Soc., J.* 53. *pp.* 1296–1304, *April,* 1931.—The dielectric constants and densities of dilute solutions of the phenyl-substituted ethylenes and acetylenes have been measured between 10° and 70° C., the molar refractions of the substances have been determined and the data used to calculate the electric moments of the molecules. The results, together with those of Errera for acetylene dihalides, have been examined in the light of electronic theories of valence [see Abstract 735 (1930)]. The phenyl substituted ethylenes have small or zero moments according to the symmetry of their arrangement about the double bond, showing that there is no measurable polarity inherent in the bond itself. The replacement of a hydrogen on a doubly-bonded carbon by a hydrocarbon group gives rise to a moment of the same magnitude as that which results from a similar replacement in benzene. The considerable moment found for phenylacetylene and the still larger value for diphenylacetylene, acetylene itself having no moment, give evidence of unsymmetrical molecules and may be explained in terms of a tautomeric equilibrium between a symmetrical form and an unsymmetrical containing bivalent carbon as proposed by Nef, the shift of equilibrium with temperature perhaps causing the temperature variation of the moment observed. H. H. Ho.

2760. Dielectric Properties of Antimony Pentachloride and Phosphorus Pentachloride. J. H. Simons and G. Jessop. *Am. Chem. Soc., J.* 53. *pp.* 1263–1266, *April*, 1931.—The molar polarisations of $SbCl_5$ and PCl_5 have been measured in CCl_4 solutions and the dipole moments concluded to be either zero or very small. The apparatus used has been already described by Lowry and Jessop [see Abstract 3198 (1930)]. The dielectric constants have also been measured for both liquid and crystalline states and the specific conductivity of PCl_5 determined. It is assumed that both these compounds have a symmetrical structure with a ten-electron shell for the central atom. H. H. Ho.

2761. Dipole Moments of Organic Halides. A. Parts. *Zeits. f. phys. Chem.* 12. *Abt. B.* 4. *pp.* 312–326, *April*, 1931.—It is shown for the propane and pentane halides as for the previously-investigated butane compounds [see Abstract 2618 (1930)] that the dipole moments decrease in the order tertiary, secondary and primary. Allyl bromide possesses an approximately $0\cdot15 \times 10^{-18}$ smaller moment than propyl chloride. A method is proposed for calculating the polarisation of dissolved substances at infinite dilution which permits the accuracy of single determinations to be ascertained. The dipole moments of benzyl-, benzal- and benzotri-chlorides are found to be $1\cdot85 \times 10^{-18}$, $2\cdot05 \times 10^{-18}$ and $2\cdot15 \times 10^{-18}$ respectively. Comparison with the dipole moments of methyl chloride, methylene chloride and chloroform shows that the replacement of hydrogen by phenyl inhibits the extension of the valency of the central carbon atom, whereby also the compounds now measured exhibit larger moments than those calculated by vector addition of component moments at the tetrahedral valency angle of 109° 29′. H. H. Ho.

2762. Dipole Moment and Kerr Effect. E. H. L. Meyer. *Phys. Zeits.* 32. *pp.* 290–293, *April* 1, 1931. *Paper read before the Deut. Phys. Gesell., Dresden, January*, 1931.—Gases and liquids are optically isotropic even when they consist of anisotropic molecules, since they are orientated in all possible directions, but anisotropy must be observed when an external electric field is imposed. The double refraction of the Kerr effect is thus a measure of the molecular anisotropy, and this is examined for the *o*-, *m*- and *p*-dichlorobenzenes, and for monochlorobenzene. The series for the Kerr constants is found to be ortho-, mono-, meta-, and para; although further work is held to be necessary for a definite conclusion. H. H. Ho.

2763. Theories of the Electricity of Thunderstorms. R. A. W. Watt. *Roy. Meteorolog. Soc., J.* 57. *pp.* 133–142, *April*, 1931.—The history of the water drop is reviewed, its adsorption of ions during ascent or descent, loss of ions by photoelectric action, changes produced by collision, by friction of water particles, ice particles and dust, and by their disruptive end. Next the observational criteria are considered: (1) the visual, including photographs of lightning discharges and the more brilliant and prolonged earth to cloud discharges; (2) the magnetic; and (3) the electrical, including direct and bound charges, potential gradient at the earth's surface and changes at discharge, air-earth current discharges, charge on precipitation, and electromagnetic induction and radiation effects. Finally, the theories advanced by Simpson, Appleton, Watt and Herd, Schonland and Craib and Wormell are reviewed. R. S. R.

2764. Origin of Local Heat Thunderstorms. Part I. H. v. Ficker. *Preuss. Akad. Wiss. Berlin, Ber.* 3. *pp.* 28–39, 1931.—Thunderstorms developed at a cold front are excluded from the discussion. The characteristics of local heat thunderstorms such as the localised ascent of air and their occurrence only in the warm half of the year are mentioned. Local horizontal temperature differences can start the air motion, and if the vertical temperature gradient and the quantity of water vapour are sufficient the process will continue. It is considered that with surface heating instability proceeds stage by stage in successive layers with a localised ascent of air and relatively cooler air descending, the latter developing into a cold front in the rear of the storm and sometimes intensified by the cooling due to precipitation. Conditions which increase or decrease the chances of thunderstorm development are discussed. The penetration of the ascending air column into the cirrus levels and the spreading out of this layer often produce an instability in these levels and assist the propagation of the storm at night. Individual cases are to be discussed in a later paper. R. S. R.

2765. Existence of Bead-like Lightning Flashes. E. Mathias. *Comptes Rendus*, 192. *pp.* 653–655, *March* 16, 1931.—The observations of this type of lightning flash by Daniel and Rouget at Flamincourt on May 30, 1930, and by Luizet at Mt. Sappey on August 15, 1907, are described and the comments on these observations by Luizet and de Haas summarised. The author considers that, of the series of flashes seen, all but the last if separated by a time interval equal to, or a little greater than, $0 \cdot 1$ sec. will be seen by the eye as separate flashes. If the last is feebler and the time interval much above $0 \cdot 1$ sec. the eye may see the globular or linear masses in the chain separated. If the time interval is $< 0 \cdot 1$ sec. this chain-like flash is projected on to the former flash and a continuous chain is seen. In the delayed flash the fulminating matter would have cooled and be more or less red and not white. The different types of flash thus depend solely on the time interval before the feeble flash is produced. R. S. R.

2766. Earths for Lightning Conductors. V. Schaffers. *Ann. Soc. Sci. de Bruxelles*, 51. *pp.* 21–26, *March* 12, 1931.—Measurements on the response to spark discharge by water and sand with varying amounts of water were made. Two metal balls connected to an influence machine and Leyden jars were plunged successively into the different substances. In one circuit there was an adjustable air gap. The ohmic resistance and discharge potential between the balls were measured. The water changes the former very much but the latter very little. A comparison with Gyemant's experiments with oil and water indicates that ionisation round the balls is important, a fact supported by the luminous aureole. The conclusion is drawn that the dielectric capacity of the soil used for earthing a lightning conductor is the important factor and not the ohmic resistance, and the former varies little from very dry to damp soil. R. S. R.

2767. Variations of Parasitic Atmospherics during the Lunar Eclipse of April 2, 1931. R. Bureau. *Comptes Rendus,* 192. *pp.* 975–977, *April* 20, 1931.—Registrations of atmospherics were made at Mt. Valérien and St. Cyr and curves indicate their mean frequency per minute for the period March 31st to April 3rd for wave-lengths of 6000 and 25,000 m. and for the former with mean and maximum sensitivity of the relay. Each curve shows the diurnal variation with maxima at night and in the afternoon and the quick fall at sunrise. At 18 hours, April 2nd, when the total lunar eclipse began, a rapid decrease of atmospherics occurred which showed a greater and more lasting anomaly with the relay having a mean sensitivity. It is thought that the lunar eclipse affects the propagation of waves from the seat of atmospherics and acts more on strong atmospherics. [See Abstract 4078 (1930.)] R. S. R.

2768. Opposed Fields and Mobility of Small Ions. J. Scholz. *Gerlands Beitr. z. Geophys.* 29. 2. *pp.* 226–238, 1931.—Measurements were made at Potsdam with the Gerdien and Ebert forms of apparatus to test the existence of an opposed field found by Itiwara [see Abstract 1993 (1931)] with the Langevin apparatus. This field was found to act most on the small ions. The measurements showed that in the determination of the number of small ions a large error occurred which could be diminished by using an earthed cylinder suspended inside the aspiration cylindrical collector. Graphs of the measurements show a remarkable relation to the current-mobility characteristic and provide an easier and more exact way to obtain the mobility of the ion. [See also Abstract 2385 (1931).]
R. S. R.

2769. Aurora Borealis. E. Brücke. *Terr. Mag.* 36. *pp.* 41–52, *March,* 1931.—Störmer's method of calculating the motion of an electron under the influence of an elementary magnet, producing a field as nearly as possible similar to that of the earth, is described [see Abstracts 269, 607, 1346 (1931)], and several theoretical paths are drawn, agreeing closely with photographs of paths experimentally obtained. Experimental support is also obtained for the assumption of the presence of a ring current parallel to the magnetic equator as the explanation of the extension of auroræ far south of the limit allowed by the original theory. C. A. S.

2770. Audibility and Lowermost Altitude of the Aurora Polaris. S. Chapman. *Nature,* 127. *pp.* 341–342, *March* 7, 1931.—The usually accepted height of the aurora is at about 100 km. and above, with a few cases at 80 km. while rising even to 800 km. Reports of observations of auroræ at lower levels and of associated sounds have been collected by Tromholt in Norway and J. H. Johnson in Alaska, and these are discussed. They include reports of auroræ even to ground level but frequently oscillating while the nature of the sound varies considerably. It is hoped that opportunities will occur during the new Polar Year (1932–33) for a critical examination of these occurrences. R. S. R.

2771. Variability of Quiet-Day Diurnal Magnetic Variation. Part II. S. Chapman and J. M. Stagg. *Roy. Soc., Proc.* 130. *pp.* 668–697, *March* 3, 1931.—The previous paper related to the daily magnetic variation, on really quiet days, at Eskdalemuir and Greenwich [see Abstract 2286 (1929)]. Part II also includes Ebro, San Fernando, Batavia and Mauritius. The stations range over 75° of geographical latitude, and 85° of magnetic latitude—this spread in latitude was intentional. It would have been better for the purpose in view to have all the stations with the same longitude, since the investigation primarily refers to Greenwich days. This was not possible for the southern hemisphere. It has been found that there is a definite tendency, on quiet days, for departures of the daily range from the normal to have the same sign at all the stations, and in all the elements concerned. The correlations are closer the nearer the observatories, and their magnitudes are considered with reference to the form and intensity of the hypothetical current system in the atmosphere, to which the S_σ field may be attributed. Changes in S_σ seem likely to be due to the solar ionising agency that produces the conductivity of the atmospheric layer concerned. This may also play some part in producing the e.m.f. The regional irregularities in ionisation are probably not directly solar, and seem to be due to terrestrial causes, such as the irregular height distribution of upper atmosphere air density. H. N. A.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

2772. Electrical Conductivity of Flames. H. A. Wilson. *Rev. Modern Physics*, 3. *pp.* 156–189, *Jan.*, 1931.—This article deals mainly with the electrical conductivity of ordinary Bunsen gas flames such as are obtained by burning a mixture of coal or natural gas and air, usually with sufficient air to make the flame as hot as possible and so more than enough to make it " non-luminous." Experiments are described with the object of clearing up discrepancies between the results of different workers in this field. §1 considers the relation between current, potential and distance between electrodes in a Bunsen flame; §2 deals with the Hall effect in flames; §3 describes the effect of a magnetic field on the conductivity of a Bunsen flame; §4 records the conductivity of flames containing alkali metal salts; §5 discusses the variation of the conductivity with the temperature and pressure; and §6 for rapidly alternating currents; §7 investigates the vertical potential gradient in flames; §§ 8, 9 and 10 deal respectively with the amplification of electric currents, direct determinations of the mobility of the electrons, and diffusion of alkali metal vapours in flames. H. H. Ho.

2773. Electrical Resistivity of Silicon. C. Bedel. *Comptes Rendus*, 192. *pp.* 802–804, *March* 30, 1931.—With special precautions to secure compact samples and good contact the resistivities of silicon containing 0·1, 1·4 and 8·5 % of iron are found to be respectively 0·267, 0·069, and 0·035 ohm/cm. C. A. S.

2774. Steepness of the Transition Curve of Superconductors. W. J. de Haas and J. Voogd. *K. Akad. Amsterdam, Proc.* 34. 2. *pp.* 192–203, 1931. *Comm. No.* 214*c from the Phys. Lab., Leiden.*—Single-crystal wires of pure tin were made having different axial orientations. It was found that the range of temperature within which the resistance of these wires vanishes (usually a few hundredths of a degree) is shorter the more perfect the crystalline state of the wire. The shortest temperature ranges occur for good single-crystal wires. The effect of the measuring current on the resistance is due to its magnetic field; it is such that the lower limit of the temperature range within which the resistance vanishes is shifted downwards by an increase in the measuring current whilst the upper limit remains unchanged. Whatever the orientation of the crystal axes, superconduction always sets in at the same temperature. Under perfect conditions the occurrence of superconduction would be discontinuous. [See also Abstract 2952 (1930).] G. E. A.

2775. Possible Anomalies in the Resistance of Metals at Low Temperatures. S. Choubine. *Comptes Rendus,* 192. *pp.* 1020–1021, *April* 27, 1931.—Fermi's partition function is applied to deduce a possible anomalous rapid increase at low temperatures of the resistance of metals with temperature, which is possibly related to the phenomenon of superconduction at low temperatures. Evidence in favour of this relationship is briefly discussed. J. S. G. T.

2776. Collisions of the Second Kind and their Effect on the Field in the Positive Column of a Glow Discharge in Mixtures of Rare Gases. L. B. Headrick and O. S. Duffendack. *Phys. Rev.* 37. *pp.* 736–755, *March* 15, 1931.—By means of electrical measurements and spectroscopic observations a study was made of the collision processes in the uniform positive column of a glow discharge in mixtures composed of two of the rare gases, helium, neon and argon and a mixture of each of these gases with mercury vapour. The results show that the electrical and spectral characteristics of the uniform positive column in mixtures of monatomic gases can be explained principally in terms of collisions of the second kind between the ions or metastable atoms of one gas and the neutral atoms of the other. The necessary condition for a large effect to be produced in the electrical and spectral characteristics of the positive column by a small percentage of one gas added to another is that a close resonance exists between the metastable states of the main gas and the ionisation potential or excited states of the added gas or ion. By the introduction of as little as 0·4 % of neon or argon into helium a marked increase in the electrical field is produced, and the spectrum emitted is changed almost completely from the arc spectrum of helium to that of neon or argon respectively. The addition of mercury vapour at room-temperature to neon caused a decrease of 45 % in the field. H. L. B.

2777. Oscillations in the Glow Discharge in Argon. G. W. Fox. *Phys. Rev.,* 37. *pp.* 815–820, *April* 1, 1931.—Report is made of radio-frequency oscillations observed in argon glow discharges. The frequencies lie in the range of 10^4 to 10^5 cycles/sec. in approximate harmonic relations. They are very sensitive to pressure changes but appear to bear no relation to the tube current. The peculiar action of a magnetic field on the oscillations is described. Some frequency calculations are made on the assumption that the potential distribution throughout the Faraday dark space can be represented by a parabola. [See also Abstract 3527 (1930).] AUTHOR.

2778. Effect of Electrical Wind in Electrical Gas Purification. W. Deutsch. *Ann. d. Physik,* 9. 2. *pp.* 249–264, *April* 25, 1931.—It is found that the suspended particles carried over in electrical gas-purification installations by the electric wind require for their deposition from the current of the electric wind about as long an interval as for a static gas without the assistance of an electric wind. The latter has therefore only a secondary effect, in contradiction to the conclusions of Ladenburg and Tietze [see Abstract 599 (1931)]. H. H. Ho.

2779. Starting Potentials of the Corona Discharge in Neon. F. M. Penning. *Phil. Mag.* 11. *pp.* 961–980, *April*, 1931.—Experiments with pure Ne and Ne-A mixtures are described in which the starting potentials of a corona discharge between a wire and a cylinder are measured as a function of the pressure. With the pure gas the starting potential with the discharge wire positive was found to be higher than that with the wire negative. Both starting potentials are lowered with the addition of small amounts of A. This is the result of the ionisation of A atoms by metastable Ne atoms. The decrease of the starting potential is greater with the wire positive than with the wire negative. A possible explanation of this is suggested. Preliminary experiments on pure and impure He and A indicate results similar to those obtained with neon. A. J. S.

2780. Form and Structure of Sparks. Part VIII. T. Terada, U. Nakaya and R. Yamamoto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 298. *pp.* 189–217, *April* 28, 1931.—The "flame-like" spark obtained when a slate-pencil resistance of $10^6 - 10^9$ ohms is placed in a circuit of large capacity and the p.d. across the spark-gap is raised gradually has been further studied. The length of the spark-gap must not be too large compared with the electrode diameter. The form and structure of the sparks as well as their behaviour to air jets are influenced considerably by the magnitude of the series resistance. The influence of hot-wire electrodes and hemispherical protuberances on one of the electrodes on the nature of the spark has been studied. When the p.d. is applied to the gap at once instead of the usual gradual charging up it is found that the characteristic differences in the nature of the sparks obtained in different gases become less marked and almost disappear if the steepness of the incident surge is great enough. F. J. W.

2781. Phenomena of Propagation in Gases Ionised by H.F. Discharge. (Miss) M. Chenot. *Comptes Rendus*, 192. *pp.* 673–675, *March* 16, 1931.—The previous work of the author [see Abstract 2014 (1931)] has been continued, and it has been found that, when the wave is reflected by a rigid wall (glass, mica, aluminium, copper), there is always a dark space in contact with the wall, a current node. If the tube opens at the end into a large bulb, reflection takes place where the tube joins the bulb. The last luminous patch is cut off near the middle in a bright patch which corresponds to a loop. This agrees with the explanation that an oscillatory movement of electrified particles is propagated. Experiments have been made with a magnetic field by bringing a bar magnet near the tube at right angles to its axis; the results agree with the above explanation. Considers the "plasmoids" observed by Wood, and the explanation of these given by Tonks and Langmuir. In verifying this theory the author has propagated h.f. vibrations in a medium ionised by discharges of much lower frequency, and has found that the distance between the nodes increases with the ionisation. H. N. A.

2782. Ionisation of Mercury Vapour by Electron Impact. P. T. Smith. *Phys. Rev.* 37. *pp.* 808–814, *April* 1, 1931.—Quantitative measurements have been made of the total number of positive charges per electron per cm. path at a definite pressure and temperature in mercury vapour as a function of the energy of the impacting electrons out to 750 volts. The maximum efficiency 19·40 occurs at about 85 volts. "Ultra-ionisation potentials" were found at 10·60, 10·76, 10·88, 11·06, 11·27, 11·40, 11·55, 11·70, 11·78, 11·92, 12·00, 12·06, 12·17, 12·28, 12·40, 12·77, 13·55, 18·20, 19·36, 20·40 and 29·50 volts. Most of these agree with those previously observed. [See also Abstract 954 (1931).] AUTHOR.

2783. Corrected Values for the Coefficient of Recombination of Gaseous Ions. O. Luhr and N. E. Bradbury. *Phys. Rev.* 37. *pp.* 998–1000, *April* 15, 1931.—Previously-published values [see Abstracts 3816 and 4094 (1930)] of the coefficient of recombination are found to be 12 % too high because of the distortion of the field between the plates of the ionisation chamber. Corrected values which may be used for the purpose of calculation are given as follows: Air, $(1\cdot23 \pm 0\cdot1) \times 10^{-6}$; O_2, $(1\cdot32 \pm 0\cdot1) \times 10^{-6}$; N_2 and A, $(1\cdot06 \pm 0\cdot1) \times 10^{-6}$; H_2, $(0\cdot28 \pm 0\cdot05) \times 10^{-6}$. AUTHORS.

2784. Elastic Scattering of Slow Electrons in Argon. E. C. Bullard and H. S. W. Massey. *Roy. Soc., Proc.* 130. *pp.* 579–590, *March* 3, 1931.—The angular distribution of slow electrons scattered elastically in argon has been investigated over a wide angular range (from 15° to 125°). Scattering curves have been obtained for 4, 6, 8, 10, 12, 16, 20, 30 and 40-volt electrons. All exhibit maxima and minima analogous to those that occur when light is scattered by small spherical obstacles. These results are described and their bearing on the Ramsauer-Townsend effect is discussed briefly. Reference is also made to the theoretical work of Holtsmark and Oppenheimer. H. L. B.

2785. Diffraction of Electrons in Mercury Vapour. F. L. Arnot. *Roy. Soc., Proc.* 130. *pp.* 655–667, *March* 3, 1931.—Describes an investigation of the angular scattering of electrons in mercury vapour, over an angular range of from 18° to 126°, using the apparatus previously described by the author [see Abstract 1584 (1930)]. Fifteen different velocities of the primary beam, ranging from 8 to 800 volts were employed. All the scattering curves show distinct maxima and minima, and maxima of four different orders were obtained. It is found that on increasing the velocity of the incident electrons the second order maximum at first moves in to smaller angles. At $V_0 = 19$ volts it begins to move out to larger angles, until $V_0 = 46$ volts, when it again changes direction and moves in steadily until it becomes lost in the main peak at 0°. This change in direction of movement between 19 and 46 volts is probably due to a hump in the cross-section curves for mercury vapour, which occurs in this velocity region. H. N. A.

2786. Electron Diffraction and Molecular Structure. R. Wierl. *Ann. d. Physik*, 8. 5. *pp.* 521–564, *March* 18, 1931.—A fine homogeneous beam of fast electrons is passed through a thin layer of vapours of different substances and the transmitted intensity is recorded photographically. The photographs are worked out by a registering microphotometer. The experiments show that the angular distribution of a homogeneous beam of fast electrons transmitted through the vapour is characteristic of the structure of the individual molecule of the vapour. By using the de Broglie wave-length corresponding to the electrons in the beam it is possible to apply Debye's theoretical formula for the distances between atoms in the molecule in the manner already done for X-rays. All vapours that remain undecomposed in the vapour state may be investigated in this way. The results obtained for twenty different substances are given and are, in part, compared with those obtained by other experimental methods. The substances are: Br_2, CO_2, CS_2, SO_2, N_2O, CCl_4, $SiCl_4$, $GeCl_4$, $TiCl_4$, $SnCl_4$, $CHCl_3$, CH_2Cl_2, CBr_4, BCl_3, PCl_3, C_6H_6, C_6H_{12}, C_5H_{10}, C_6H_{14}, C_6H_{12}. H. L. B.

2787. Angular Distribution of Electrons Scattered by Mercury Vapour. J. M. Pearson and W. N. Arnquist. *Phys. Rev.* 37. *pp.* 970–977, *April* 15, 1931.—Instead of using pressures of the order of 10^{-2} mm. an apparatus is described which is designed for pressures in the range 10^{-3} to 10^{-4} mm. Heavy primary current densities are used to afford measurable scattered currents, and high-angle scattering is found to be more easily measurable. It is found that the angular distribution curves for electrons scattered by mercury are not monotonic functions of the angle of scattering. For a given energy of incident electrons the curve passes through a minimum, the angular position of which depends upon the energy. AUTHORS.

2788. Influence of Radiative Forces on the Scattering of Electrons. N. F. Mott. *Cambridge Phil. Soc., Proc.* 27. *pp.* 255–267, *April,* 1931.—The author has previously suggested [see Abstract 3254 (1929)] that, in the case of the large-angle scattering of electrons with velocity comparable with that of light, the radiative forces might influence the scattering appreciably. It is shown, however, in the present paper that for electrons of any velocity the influence of these forces cannot be greater than 2 or 3 %, and cannot explain the large discrepancies existing between theory and experiment. Using Dirac's radiation theory an expression is found for the probability that an electron scattered by collision with an atomic nucleus through an angle θ should emit a quantum of frequency between ν and $\nu + d\nu$; this is given in terms of v the velocity of the electron before losing energy, and v' the velocity afterwards; a formula is also arrived at for the total number of electrons scattered into any solid angle. The continuous X-ray emission spectrum has been treated more adequately by Gaunt, but a result can be obtained from the author's formulæ, and this compares satisfactorily with that of Gaunt. Kramer's formula is also considered. H. N. A.

2789. Production of Protons. C. Ramsauer, R. Kollath and D. Lilienthal. *Ann. d. Physik,* 8. 6. *pp.* 702–708, *March* 23, 1931.—An apparatus was constructed similar to that described by Dempster [see Abstract 1431 (1926)] by which protons can be produced and the conditions of their origin investigated. The intensity of protons is within a wide range proportional to the intensity of electrons. J. J. S.

2790. Effective Cross-Section of Gas Molecules with respect to Slow Protons. C. Ramsauer, R. Kollath and D. Lilienthal. *Ann. d. Physik,* 8. 6. *pp.* 709–736, *March* 23, 1931.—The conception of the effective cross-section of gas molecules with respect to slow electrons is widened so as to apply equally to protons. The limitations of the definition owing to its dependence on the dimensions of the apparatus used are discussed. In the present case the apparatus used resembles that devised by A. J. Dempster for the analysis of mass-rays. The protons are released by bombarding a lithium surface with electrons, and the path of the protons is defined by a system of slits of various dimensions. The protons move round a quadrant of a circle under the influence of a magnetic field. The emerging protons, which may be considered to be moving with uniform velocity, then pass through the gas under examination, the intensity of the stream of protons being measured after a distance of 40 cm. has been traversed in the gas, and again, by a second electrometer, after a further 70 cm. have been traversed. The diminution of the stream at the end of these two straight paths allows the effective cross-section, as defined by Ramsauer, to be determined. Measurements have been made with He, Ne, A, H_2 and N_2 at pressures between $1 \cdot 10^{-4}$ and $500 \cdot 10^{-4}$ mm. of mercury. The results are plotted with the effective cross-section as ordinate and the velocity of the protons in terms of $\sqrt{V}$ as abscissa. The curves obtained for Ne, A, H_2 and N_2 all pass through a minimum value. This minimum moves to lower values with the ionisation potential of the various gases. The results obtained are of the same order as those deduced for the cross-sections with respect to slow electrons. The authors compare the results with those obtained by G. P. Thomson, who used a photographic method. H. L. B.

2791. Photoelectric Cells and Filters. L. R. Koller. *Rev. Sci. Instruments,* 2. *pp.* 195–198, *March,* 1931.—In a number of practical applications light is passed through a coloured solution and allowed to fall upon a photoelectric cell. The photoelectric current due to the transmitted light is then used as a measure of the concentration of the solution. The sensitiveness of this method can be greatly increased by the use of suitable filters. This is due to the fact that the change of transmission with concentration is not the same for all wave-lengths. If those wave-lengths which are least affected by changing concentration are filtered out, the intensity of the remaining light will show a proportionately greater change with concentration. The reduction in the initial photoelectric current is not of great importance as in most cases it is possible to use a source of high intensity. E. E. F. d'A.

2792. Influence of Resistance on the Discharge of a Photoelectric Cell. G. A. Boutry. *Comptes Rendus,* 192. *pp.* 620–622, *March* 9, 1931.—Studies the effect on the characteristic surface of a photoelectric cell when the external resistance is increased beyond 500,000 ohms [see Abstract 2426 (1931)]. E. E. F. d'A.

2793. Photoelectric Emission from Thin Layers of Potassium and Cæsium. R. Fleischer. *Phys. Zeits.* 32. *pp.* 217–218, *March* 1, 1931. *Paper read before the Deut. Phys. Gesell., Dresden, Jan.,* 1931.—Potassium or cæsium vapour is deposited on transparent gold leaf (of 1000 Å. thickness) in a vacuum. The leaf is suspended transversely in a cylindrical vessel both ends of which are closed by quartz discs. The radiation used consisted of monochromatic unpolarised light from 3650 to 6230 Å. The number of photoelectrons released is measured by means of a quadrant electrometer. In the case of the potassium layer a maximum output was obtained at 4360 Å.; its value was $37 \cdot 9 \times 10^{-2}$ coulombs per cal. Since the quantum equivalent of this line is $1 \cdot 48$ coulombs per cal., this output amounts to $25 \cdot 7$ %. In the case of cæsium the maximum output obtained was $10 \cdot 3$ % at 4920 Å. H. L. B.

2794. Improvement of Thin-Film Cæsium Photoelectric Cells. S. Asao and M. Suzuki. *I.R.E., Proc.* 19. *pp.* 655–658, *April,* 1931.—The photoelectric sensitivity of thin films of cæsium deposited on silver oxide with silver as a base metal was studied by L. R. Koller [see Abstract 1593 (1930)]. Photoelectric cells with sensitive surfaces made in this manner have a maximum sensitivity in the short-wave range and also a second maximum in the red, with the long wave-length limit moving out into the infra-red. The authors have found that if a thin film of silver or gold is deposited on the above sensitive kathode surface and afterwards baked, it becomes very much more sensitive and shows displacements of the long wave-length limit still further in the infra-red. By this new method, which is described in the paper, sensitivities as high as 40 and even 48 microamperes per lumen have been obtained. This is several times better than for the cæsium on silver oxide and about thirty times better than potassium hydride cells. The new sensitive surface or kathode thus formed may be considered to have a thin film of cæsium, over which is deposited, as a final layer, a thin film of silver. The sensitivity as reported was measured with a gas-filled tungsten lamp operating at 2700° K. AUTHORS.

2795. Direction of Emission of Photoelectrons. P. Auger and (Miss) T. Meyer. *Comptes Rendus*, 192. *pp.* 672–673, *March* 16, 1931.—The experiments were made with the Kα rays of uranium, acting on argon, using the apparatus previously employed [see Abstracts 1653 and 2273 (1929)]. A table is given in which the results are compared with those of previous experiments on argon, using the Kα rays of molybdenum and tungsten.

λ effective (in Å.)	0·87 (Mo)	0·22 (W)	0·134 (U)
σ	1·41	1·34	0·30
S	1·90	1·56	1·45

σ is the ratio between the impulses of the electrons in the direction of the beam, and those of the X-ray quanta (photons); S is the asymmetry, the ratio of the cosine of the angle of bipartition to the cosine of the angle of forward projection θ of the electrons, obtained by a simple application of the classical formulæ for the pressure of radiation. Sommerfeld's value for S, obtained by means of wave mechanics, was 1·8, which he has since corrected to 2. The authors' values are nearer to Sommerfeld's first value than to his second. H. N. A.

2796. Photoelectric Action of Semi-Conductors. G. Mönch. *Zeits. f. Physik*, 68. 3–4. *pp.* 244–256, *March* 20, 1931.—Experiments on the external photoelectric action in semi-conductors have shown that this action does not differ essentially from that of metals. In both cases there is a long-wave limit and a yield increasing with frequency. This fact suggests that in the case of semi-conductors also there is a contact potential. Such contact potential is independent of the metallic base. The potentials obtained by Thomson's method are equal to the values obtained by observing the parallel displacement of emission lines. [See also Abstract 3545 (1930).] E. E. F. d'A.

2797. Effect of Secondary Emission on Valve Characteristics. H. Bittmann. *Ann. d. Physik*, 8. 6. *pp.* 737–776, *March* 23, 1931.—In order to investigate the systematic irregularities in the dynatron characteristic a simple and accurate bridge method was developed for measurement of the negative steepness using a.c. By this method the effects of variation of grid potential, magnetic field and of shape and disposition of the electrodes were investigated. With plane electrodes it is shown that the irregularities in the dynatron characteristic are caused by the spacial discontinuity of the collecting electrode. With a plate for collecting electrode the behaviour of the curve is regular, the change from this arrangement to one with a grid being shown by means of an auxiliary electrode. The occurrence of irregularities is explained as due to the exchange of secondary electrons between the grid and filament; the practical applications of this are discussed specially with reference to double grid valves. With regard to the number of effective secondary electrons it is shown that it can be reduced to about the fourth part by the use of a net-formed anode. It depends very much on the condition of the anode as regards being degassed. Deposit of oxide on the anode increases appreciably the number of secondary electrons, the increase being greater for barium than for strontium oxide. [See also Abstract 1982 (1930).]

A. W.

2798. Fermi-Dirac Statistics Applied to the Problem of Space Charge in Thermionic Emission. R. S. Bartlett. *Phys. Rev.* 37. *pp.* 959–969; *Disc.*, 969, *April* 15, 1931.—This paper develops mathematically the state of an electron gas in equilibrium with a plane electrode when the electron gas obeys the Fermi-Dirac rather than the classical distribution law. For a part of the range of integration graphical methods were found necessary, but fortunately a change of variable leads to a solution, shown graphically, which is independent of the temperature and of the nature of the emitting electrode. Thus a single graphical integration can be applied to any emitting surface at any temperature, giving the density, electric intensity, and potential at any desired distance from the surface. A simple extension of the theory makes possible the calculation of the thermionic current between plane electrodes. Numerical examples are given, and the validity of the assumptions is discussed briefly.

AUTHOR.

2799. Skin Effect. M. J. O. Strutt. *Ann. d. Physik*, 8. 7. *pp.* 777–793, *April* 1, 1931.—Treats mathematically the current distribution in a finite body of any shape when placed in an alternating electromagnetic field. Two cases are considered, one in which the electric potential between two given points is maintained constant, and one in which the magnetic potential (line integral of the magnetic field strength) is constant, and in each case the dissipation of energy and its relation to frequency are examined. It is found that at low frequencies the energy dissipation in the body is a function of the square of the frequency, and at high frequencies it is a function of the square root of the frequency. G. E. B.

2800. Ferromagnetism and Electrical Characteristics. Part II. W. Gerlach. *Ann. d. Physik*, 8. 6. *pp.* 649–662, *March* 23, 1931.—The longitudinal magnetic increase of resistance of ferromagnetic bodies at constant temperature, at different temperatures and according to previous magnetisation is found to be proportional to a function involving the square of the magnetisation. The ideal case is found for a single crystal of iron. A hypothesis is postulated and substantiated that the increase in resistance first of all begins when a critical magnetisation is exceeded, which establishes the component of the natural spontaneous magnetisation in the direction of the field. Experimental and theoretical details are fully quoted. S. G. B.

2801. Ferromagnetism. R. H. Fowler and F. C. Powell. *Cambridge Phil. Soc., Proc.* 27. *pp.* 280–289, *April,* 1931.—Amplifies the discussion and conclusions of a recent paper by Powell [see Abstract 1674 (1931)]. His theory is shown to have a close connection with that of Akulov, and makes it possible to deduce that if the axes of the atomic angular momenta are suitably situated the direction of easiest magnetisation will be the (1, 0, 0) and similar directions in iron, and the (1, 1, 1) and similar directions in nickel, in agreement with the facts. The (*l*, *s*) interaction between the spins of the pivoting magnetic electrons and the non-pivoting orbital momentum of the atoms of the crystal to which they belong, deduced from the deviation effect, yields energy differences between the states of holomagnetisation along the easiest and other directions, of the right order to account for the observed extra work of magnetisation required. The theory has been worked out semi-classically, and not quantum-mechanically as Heisenberg has done with his simpler model. There is, however, some reason to expect that a fair approximation has been reached. Not only are the magnetisation curves of iron and nickel dealt with, but also those of cobalt, the lattice of which is hexagonal, close-packed; the theoretical curves agree with those observed. H. N. A.

2802. Magnetism and Molecular Structure. Part II. Influence of Position Isomerism on Diamagnetic Susceptibilities. S. S. Bhatnagar and R. N. Mathur. *Phil. Mag.*, 11. *pp.* 914–926, *April,* 1931.—The facts observed in Part I [see Abstract 4111 (1930)] were confirmed by a number of observations on new isomers, made with the same apparatus as before. Observations on propyl alcohol, isopropyl alcohol, normal butyl alcohol and tertiary butyl alcohol, at a number of temperatures between 25 and 50° C., show that their specific susceptibilities are practically independent of the temperature. It is shown that the differences between the magnetic susceptibilities of position isomerides are not due to different degrees of their molecular association to any great degree; and an attempt is made to explain the differences on the basis of differences in the electronic orbits in the isomerides concerned. Butyl bromide and isobutyl bromide are considered qualitatively from this point of view, and it is shown that the alteration in position of the bromine atom in the compound can be expected to produce an alteration in the dimensions of the electronic orbits, making the iso-compound more diamagnetic than the normal one, as is found to be the case experimentally. H. N. A.

2803. Magnetic Susceptibility of Binary Systems of Organic Liquids. (Miss) V. C. G. Trew and J. F. Spencer. *Roy. Soc., Proc.* 131. *pp.* 209–224, *April,* 1931.—Arguing from Pascal's results for the susceptibility of straight chain substances it would appear that the susceptibility of two organic liquids should be capable of calculation by the mixture law, from the values of its components. The present investigation is to determine whether or not susceptibility is a property from which conclusions can be drawn as to the characteristics of the mixture under test. Evidence of the existence of association, dissociation and compound formation in binary mixtures, etc., is required and the suitability or otherwise of susceptibility as a criterion is discussed. The determinations were accomplished by means of a modified Curie-Cheneveau magnetic balance and water was taken as the substance of comparison. The results show that in general the susceptibility of mixtures of organic liquids does not follow the simple mixture law. The relationship between molecular composition and mass susceptibility is found to be linear in a few cases. It follows, therefore, that from the above, measurements of the specific susceptibility furnish evidence from which deductions may be drawn as to whether or no physical and chemical changes occur on mixing two organic liquids. Three groups of mixtures are established: (1) ideal pairs, obeying the mixture law; (2) pairs in which a physical change occurs on mixing, *i.e.*, slight deviation from the law is shown; and (3) chemical changes occur, *i.e.*, large deviations from the law are created. Susceptibility is a property which is very sensitive to small changes in the chemical and physical natures of a substance and consequently very large deviations are found from the mixture law when a marked change occurs. S. G. B.

2804. Magnetic Properties of Matter in Strong Magnetic Fields. Part I. The Balance and its Properties. Part II. Measurement of Magnetisation. P. Kapitza. *Roy. Soc., Proc.* 131. *pp.* 224–273, *April*, 1931.—The present paper describes a new method for the measurement of susceptibility, and results are given which verify the linear law of magnetisation for several paramagnetic and diamagnetic substances. The measurements can be made in a small fraction of time. A h.f., damped, sensitive type of spring balance is described by means of which it is possible to measure forces of a few gm. in a time of the order of 0·01 sec. The theory of this balance is developed to supply a general practical formula, whilst the sensitivity, correction for inertia of moving parts, etc., are fully treated. The measurement of magnetisation of substances in short times is described and errors due to stray effects, etc., are discussed. Amongst other things, the change of temperature during adiabatic magnetisation is estimated. The method now employed for the determination of the susceptibility in strong magnetic fields in the short time available is shown to be vindicated, the results indicating an accuracy of 1 to 2 % which could be developed even further. The results show that within the range of temperature used the laws of magnetisation as given by modern theories and verified in magnetic fields up to 30 kilogauss are valid in a region of fields up to 10 times larger. The chief interest in the method is the possibility of obtaining saturation values for paramagnetic substances with fair accuracy. A description of the measurement of magnetisation of iron and nickel after saturation is given, wherein it is shown that the magnetisation remains practically constant up to fields of 280 kilogauss (within 1 %), thus agreeing with the Weiss-Langevin theory of ferromagnetism. A description is given of the separation of the ferro- and paramagnetic parts of the magnetism in some ferromagnetic alloys, and details are recorded of the measurements of the magnetisation of gadolinium sulphate and manganese. The former shows a variation from the linear law of magnetisation at the temperature of liquid nitrogen, agreeing in magnitude with the Langevin theory. For Bi the magnetisation for different crystal orientations at room-temperature and the temperature of liquid nitrogen is found to be proportional to the magnetic field. Further determinations include that of the dependence of the susceptibility on the temperature for different crystal orientations. S. G. B.

2805. Electrical and Mechanical Effects in Metal Wires Due to Thermal, Magnetic or Acoustic Influences on their Structure. A. v. Hippel and O. Stierstadt. *Zeits. f. Physik*, 69. 1–2. *pp.* 52–55, 1931.—The main experiments were made with iron wires containing only 0·001 % of impurities. A wire was clamped above in a vertical glass tube, stretched by a weight and a spring of soft copper below, the ends being connected to the transformer of a four-valve amplifier. Alterations in the structure of the iron, for instance at the instant of cooling down through the $\gamma \rightarrow \beta$ point, caused a sound in the telephone. This was regarded as due to a rush of current through the wire, caused by the sudden shift in the atoms. When the wire is suddenly magnetised a sound is heard, which seems to be due to the shift in the atoms which produces magnetostriction, which again causes a current rush. This effect does not occur with permalloy, in which there is no magnetostriction. Other effects are described which are all explained as due to a slipping which takes place between the metallic lattice and the conductivity electrons, so that the latter are set in motion producing a momentary current. One of them seems to be due to acoustical vibrations in the wire, which are reproduced in the telephone. H. N. A.

2806. Indeterminacy of Coulomb's Law. G. Lemaître. *Ann. Soc. Sci. de Bruxelles*, 51. *pp.* 12–16, *March* 12, 1931.—Heisenberg's theory for the value of the indeterminacy in the measures of an electromagnetic field found from the deviation it produces on charged particles moving through it, is applied to the case of a Coulomb field. The result is that if the point charge producing the field is small the surrounding field is almost completely indeterminate. G. C. McV.

2807. Simple Deduction of the Biot-Savart Law from the Induction Law. H. Greinacher. *Helv. Phys. Acta*, 4. 2. *pp.* 59–67, 1931.—A method by which the Biot-Savart law can be simply deduced from the law of induction is described. Starting with the case of an infinitely long straight conductor an expression for the elementary law is arrived at by treatment of the induction relations in a selected elementary current circuit. The action of a given closed current circuit appears then as compounded of a sum extended over an infinite number of elementary current circuits. The rotation of a magnet pole in the field of a current conductor is also treated. J. J. S.

2808. Determination of e/m by Velocity Measurements. F. Kirchner. *Ann. d. Physik*, 8. 8. *pp.* 975–1004, *April* 10, 1931.—The method used was somewhat similar to the original method of Wiechert, except that rapidly alternating electrical fields were used to cause deviations of the electrons instead of magnetic ones. The discharge of electrons was produced from an incandescent kathode in a high vacuum, and they passed in turn between the pairs of electrodes of two small condensers. These were connected to a valve oscillator, which produced undamped electrical vibrations. About 0·5 m. from the first condenser was a phosphorescent screen, which showed the vibrating beam of electrons as a luminous band. There was a hole in the middle of this screen, which allowed the beam to pass when it was in its undeviated position. It then passed between the plates of the second condenser in a series of current rushes, which struck a second phosphorescent screen, and in general produced two luminous patches, owing to the difference of phase due to the time taken by the electrons in passing from one condenser to the other. When this time is exactly half a period of the vibrations the two luminous patches coincide at the centre of the screen, and by adjusting so that this takes place a zero method results which is very accurate. The result was $e/m_0 = (1{\cdot}7598 \pm 0{\cdot}0025)\cdot 10^7$ e.m.u. H. N. A.

APPARATUS AND INSTRUMENTS.

2809. Combined Series and Potentiometer Rheostat. J. R. Nielsen. *Rev. Sci. Instruments*, 2. *pp.* 184–186, *March*, 1931.—Dodge has recently designed a rheostat which can be changed from the series to the potentiometer connection for regulating the current in a circuit (the load) by simply closing or opening a switch. The author treats the problem by means of Kirchhoff's laws, and derives the necessary formulæ for finding when the potentiometer connection is possible. H. N. A.

2810. Moving-Coil Instruments with a Uniform (Magnetic) Field. G. Dupouy. *Comptes Rendus*, 192. *pp.* 734–737, *March* 23, 1931.—The 17-fold greater sensitivity possible by the use of a uniform, rather than a radial field, in the construction of moving-coil voltmeters, ammeters, etc., is deduced and discussed. Ordinarily the use of a uniform field produces damping which is a function of the orientation of the coil, and instruments so constructed cannot be made aperiodic. A method of overcoming this deficiency is discussed briefly. J. S. G. T.

2811. Experiments with the Zélény Electroscope. R. Barton. *Rev. Sci. Instruments*, 2. *pp.* 217–225, *April*, 1931.—Describes a method of demonstrating certain phenomena for lecture purposes by the aid of the Zélény electroscope. Among the phenomena mentioned are the characteristics of triodes, the photoelectric effect, comparison and measurement of resistances, and the absorption of β-rays. G. E. B.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2812. Electromagnetic Switch in X-Ray Apparatus. K. W. Müller. *E.T.Z.* 52. *pp.* 410–413, *March* 26, 1931.—Owing to technical progress in the manufacture of X-ray apparatus, times of exposure are rapidly decreasing. This involves difficulties in the accuracy of timing of these short exposures, the accuracy being often limited for times below 1/10 sec. by processes in the switchgear. The action of these switches has been experimentally investigated and means devised for increasing as far as possible the accuracy of the timing. W. V. M.

2813. X-Ray Generator with a Water-cooled Rotating Target. A. Müller. *Brit. J. of Radiology*, 4. *pp.* 127–130; *Disc.*, 130–131, *March*, 1931.—In order to increase the maximum permissible loading of an X-ray tube, the target is caused to rotate, thereby increasing the effective size of the focal spot. A theoretical investigation shows that if the effective energy dissipation of a tube with a rotating target is to be increased n times, it is necessary to increase the speed of motion by n^2 times. This may be done either by increasing the angular velocity of rotation or by increasing the radius of the target. The tube described is a hot kathode tube, and the target is rotated by an external electric motor acting through a pulley, the driving shaft passing through a special stuffing box. The X-ray tube and the stuffing box are continuously evacuated by means of pumps. G. E. B.

2814. Experimental Oil-immersed X-Ray Apparatus. R. D. Bennett, N. S. Gingrich and W. C. Pierce. *Rev. Sci. Instruments*, 2. *pp.* 226–230, *April*, 1930.—In order to reduce the size and increase the safety of an X-ray h.t. generator, the entire equipment is contained in a steel tank filled with insulating oil. The h.t. generator is of 5 kVA rating, and this, together with two rectifying valves and the X-ray tube are contained in a tank of dimensions 15″ × 25″ × 48″. The " potentiometer " circuit is employed, and all the necessary controls and instruments are mounted on the tank. G. E. B.

2815. New Type of Control for X-Ray Apparatus. A. C. Gunstone and E. J. W. Watkinson. *Brit. J. of Radiology*, 4. *pp.* 166–170; *Disc.*, 170, *April*, 1931.—A new design of control table for heavy-current X-ray work is described, which, for radiographic work, incorporates the Gaiffe milliampere second relay. The auto-transformer method of measuring indirectly the secondary voltage has been dispensed with in favour of direct tappings upon the primary of the h.t. transformer. Six tappings are utilised. Automatic change-over, from screening to radiographic current values, is carried out. With known voltages only a milliammeter and a pre-reading filament ammeter are required upon the control table, and a method to allow the milliammeter to be installed on the control table is described. Mechanical inertia affects the exposure time with very heavy tube currents and very short times of exposure. B. J. L.

2816. Emotional Stimulus. Resistance-Capacity Method of Measuring Psycho-Galvanic Reflexes. G. G. Blake. *El. Rev.* 108. *pp.* 416–417, *March* 6, 1931.—The bridge and the " Tchometer " methods of measuring the variations of the body resistance, under the influence of emotion, are reviewed. The author then describes his own resistance-capacity method of measurement, which utilises a two-valve amplifier and eliminates the occurrence of galvanometer " drift." The method is simple to operate. The schematic connections are illustrated and a bibliography on the subject appended. B. J. L.

2817. Immediate and Delayed Effects of Radium (γ-Rays) on Tissue Cultures in Vitro. F. G. Spear. *Brit. J. of Radiology*, 4. *pp.* 146–165, *April*, 1931.—An historical survey of the effect of γ-rays on living tissue is given. The advantages of tissue cultural methods for purposes of research are discussed, and the technique of tissue culture is described. The author has utilised the chick choroid and sclerotic in his own experiments, and the apparatus used to expose such cultures to γ-rays of radium is described. Graphical and tabular results are given. It is found that radiation reduces the number of cells undergoing mitosis and that there is no evidence of a stimulation effect. The effect of mitosis varies with the amount of radium used, and, therefore, with the quantity of radiation, a larger amount of radium also reduces the delay which occurs before the effects of radiation become evident. The effects must be attributed directly to the radiation. Possibility of differences *in vivo* and *in vitro* are mentioned. The present work is supported by Strangeways and Fell's work of the action of X-rays on fowl embryos. Mottram has suggested the variation of different tissues, as regards their sensitivity to radiation *in vivo*, is due to variations of blood supply. An extensive Bibliography is given. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2818. Direct Measurement of Adsorption of Soluble Substances by the Bubble Method. D. M. Gans and W. D. Harkins. *J. Phys. Chem.* 35. *pp.* 722–739, *March,* 1931.—Direct measurements by the bubble method are described of the adsorption of *p*-toluidine and of isoamyl alcohol in the air-solution interface. Results are obtained in partial agreement with those of McBain and Davies, in that they represent an adsorption in excess of that deduced from the adsorption equation and that predicted by measurements of insoluble films. The adsorption secured is in general smaller than that obtained by McBain and Davies. Differences in the methods of calculation obscure the experimental discrepancy. Evidence is presented which shows that the adsorption appears to decrease as the adsorbing bubbles grow smaller, and may approach the value for each solute which is obtained from the adsorption equation and from experiments with insoluble films. Variations between the observed and calculated adsorptions are discussed. H. H. Ho.

2819. Heat of Adsorption of Organic Vapours by Charcoal at 25° and 50° C. J. N. Pearce and G. H. Reed. *J. Phys. Chem.* 35. *pp.* 905–914, *March,* 1931.—The organic vapours investigated are methyl chloride, methylene chloride, chloroform and carbon tetrachloride at 25° and 50° C., and in so far as these four vapours are concerned the temperature coefficient of the heat of adsorption is very small. The authors doubt whether there is one. These four vapours show an increase in the molecular heats of adsorption with increase in the number of chlorine atoms in the molecule. J. K.

2820. Adsorption of Vapours by Activated Charcoal. Part III. J. N. Pearce and A. L. Taylor. *J. Phys. Chem.* 35. *pp.* 1091–1103, *April,* 1931.—The adsorption of ethyl, *n*-propyl, *iso*-propyl, *n*-butyl and tertiary butyl chloride vapours by charcoal are determined for temperatures ranging from 0° C. to temperatures at which the vapours become unstable in contact with charcoal. Stability decreases with increase in molecular complexity. At low pressures and for all temperatures the volume of vapour adsorbed in the normal series increases with the molecular weight of the vapour. At sufficiently high pressure at 0° the order of adsorbability is completely reversed. [See also Abstract 3863 (1930).] J. K.

2821. Discontinuous Nature of the Process of Sorption of Gases and Vapours by Porous Solids. A. J. Allmand and L. J. Burrage. *Roy. Soc., Proc.* 130. *pp.* 610–632, *March* 3, 1931.—The results of earlier work pointing to discontinuity in the process of sorption of vapours by charcoal are reviewed, and a detailed investigation by means of a simple static technique of eight new isothermals is communicated which includes measurements (*a*) with four different charcoals and (*b*) with five different condensible vapours and also with CO_2. The data are also given from the examination by two different methods of three vapour isothermals on silica gel. All these isothermals show some evidence of discontinuity, sometimes very marked. The paper contains suggestions for the explanation of the facts observed. H. H. Ho.

2822. Tenacity and Nature of the Hydrogen Absorbed by the Platinum Metals. E. Müller and K. Schwabe. *Zeits. f. phys. Chem.* 154. *Abt. A.* 1–2. *pp.* 143–166, *April,* 1931.—Hydrogen absorbed by Ru, Rh, Os and Ir at atmospheric pressure is not released at 20° under a pressure of about 10^{-4} mm., although such release does occur with Pd and, partially, with Pt. Distinction must be drawn between molecular and atomic sorption. Both types of combination exhibit continuous transitions between two limits—the union of a hydrogen molecule or atom with an isolated metallic atom, or with one in the interior of the crystal. Within these limits the tenacity of each of these unions increases with the degree of dispersion of the metal. With Ru, Rh, Os and Ir the hydrogen taken up is only atomic, being independent of the pressure and combined only at the surface, so that it is not appreciably taken up by the compact metals. With Pd and Pt the hydrogen is partly atomic and independent of the pressure, and partly molecular, independent of the pressure in the interior of the metal; hence these metals take up hydrogen even in the compact form. In the case of Pd, the atom-sorbed hydrogen is transformed gradually into the molecule-sorbed form, and hence becomes removable by diminution of the pressure. With Pt such transformation occurs less readily and, in so far as the experiments described show, no complete release of the absorbed hydrogen could be observed. T. H. P.

2823. Adsorption of Substances by Fuller's Earth. H. J. Phelps. *Roy. Soc., Proc.* 131. *pp.* 17–29, *April,* 1931.—Propionic and hexoic acids are not appreciably adsorbed by fuller's earth at any pH. Oxalic acid is adsorbed in solutions more alkaline than pH1·5, the adsorption rising to a maximum at about pH and then diminishing very gradually with increasing alkalinity. With *n*-propylamine and *n*-butylamine, the adsorption rises from a vanishingly small value in very acid solution to about pH4·5 and then remains almost constant to pH8; a rapid rise occurs to a maximum at pH11, followed by a rapid fall to pH13. For the pH range 4·5–8, an amount of calcium virtually equivalent to the base adsorbed is displaced, whereas in more alkaline solutions practically no calcium is displaced. It is concluded that the adsorption of these bases is a true and polar process in very alkaline solutions, whereas in solutions more acid than pH8 adsorption proceeds almost entirely by the displacement of calcium ions from the fuller's earth. This view is supported by the course of the adsorption of *n*-butylamine by aluminium silicate gel. The fact that this gel does not adsorb oxalic acid at any H-ion concentration suggests that the adsorption of this acid by fuller's earth is due to the formation of insoluble calcium oxalate at the surface. T. H. P.

2824. Quantum Mechanics of Adsorption Catalysis. M. Born and V. Weisskopf. *Zeits. f. phys. Chem.* 12. *Abt. B.* 3. *pp.* 206–227, *March,* 1931.—Born and Franck's quantum-mechanical theory of the mechanism of adsorption catalysis is extended to a consideration of the reciprocal effect of the adsorbed and adsorbing substances; and by application of the method developed by Weisskopf and Wigner [see Abstract 154 (1931)] in applying quantum theory to the determination of the breadth of spectral lines, the reaction velocity of an adsorbed system is expressed as a function of its mechanical properties and the constants of the adsorbing substance. The order of magnitude of the reaction velocity is estimated for various cases. **Errata,** *ibid.* 12. *Abt. B.* 6. *p.* 478, *June,* 1931. C. A. S.

2825. Desorption of Gases from Molecularly Plane Glass Surfaces. J. R. Curry. *J. Phys. Chem.* 35. *pp.* 859–873, *March,* 1931.—Adsorbed layers of air, carbon dioxide, toluene, ammonia, hydrogen, carbon monoxide and ethylene were formed on a molecularly plane glass surface at temperatures of − 78° and 25° C. The adsorbed gas was then driven off by increasing the temperature. With the exception of carbon dioxide all the gases were completely desorbed at temperatures below 200° C. Further, the total amount desorbed even from layers formed at − 78° C. was never greater than that corresponding with an adsorbed layer one molecule in thickness. Desorption took place very slowly at room temperature, but at temperatures above 150° C. it was complete in about 1½ hr. If the glass surface was allowed to come into contact with water vapour the amount of toluene and hydrogen adsorbed increased three times. This increase is attributed to an increase in the surface area of the glass due to the solvent action of the water. F. J. W.

2826. Clean-Up Process in Hydrogen. E. Hiedemann. *Ann. d. Physik,* 8. 4. *pp.* 456–474, *March* 26, 1931.—The clean-up process in hydrogen is twofold; one, " normal " [see Abstract 3173 (1929)], due to normal surface adsorption of atomic hydrogen on the surface of the glass, removable by heating to 300°; the other, " anomalous " [see Abstract 2171 (1928)], due to hydrogen much more intimately attached to (or in) the glass, and not removable even on heating to the softening point of the glass. To investigate this an oscillating discharge was applied to a flask that had been thus heated by means of external electrodes. This removed the gas only from those parts near the electrodes, the glass at the same time becoming very brittle, indicating the occurrence of electrolysis [see Abstract 2320 (1929)]. It is finally shown that the " anomalous " clean-up is due to the production of a gas condensible by liquid air, with properties corresponding to those of a silicon hydride, with probably also a mercury hydride if mercury vapour is present. C. A. S.

2827. Desorption of Gases from the Walls of a Closed System. G. E. Pringle and G. van Praagh. *Cambridge Phil. Soc., Proc.* 27. *pp.* 250–254, *April,* 1931.—This investigation is incidental to a study of the rate of clean-up of iodine at a hot platinum filament. Iodine vapour was admitted to the reaction vessel containing the cold filament. On heating the filament the pressure of iodine decreased owing to the clean-up. Owing to the desorption of iodine from the glass walls of the reaction vessel due to this fall of pressure, the actual pressure measured at any instant is always greater than that which would be observed if the clean-up were the only process occurring in the reaction vessel. The correction which must be applied to the observed pressures in order that they may correspond with the clean-up has been calculated and found to be quite appreciable. F. J. W.

2828. Importance of Crystalline Form in the Formation of Solid Solutions. Thermal and X-Ray Analysis of the Anhydrous System, $Li_2Br_2 - MgBr_2$. A. Ferrari and C. Colla. *Accad. Lincei, Atti,* 13. *pp.* 78–80, *Jan.* 4, 1931.—Anhydrous lithium and magnesium bromides are not completely miscible, but form two series of solid solutions with a small miscibility gap. The results obtained with the binary fluoride, chloride and bromide mixtures of lithium and magnesium indicate that if, in spite of the analogy between these two metals, complete miscibility is observed only with the chlorides, this is due to the virtually identical structures of the salts. When the structures are different, as with the fluorides and bromides, only partial miscibility, with two series of mixed crystals, occurs. T. H. P.

2829. Heat of Dilution of Cane Sugar in Aqueous Solution and of Urea and Calcium Chloride in Alcoholic Solution. R. B. Vallender and E. P. Perman. *Faraday Soc., Trans.* 27. *pp.* 124–135, *March,* 1931.—Using the method of Harrison and Perman [see Abstract 1626 (1930)] with slight modifications, the heats of dilution were measured of the above solutions, over as wide ranges as possible of concentration and temperature. In the case of cane sugar, all the heats measured were negative. Urea in alcohol gave very small heats of dilution, all positive. Calcium chloride in alcohol gave negative heats of dilution and provided a series of curves very close together. On comparing the results obtained with those calculated from the vapour pressure, agreement was good for urea and calcium chloride but very poor for cane sugar. The heats of dilution for cane sugar were used for calculating osmotic pressures and the comparison of the results with a standard set of experimental osmotic pressures was good. C. O. B.

2830. Solutions for Colorimetric Standards. Part IV. M. G. Mellon and G. W. Ferner. *J. Phys. Chem.* 35. *pp.* 1025–1043, *April,* 1931.—The various factors which affect the colour of indicator solutions were investigated. The indicators were studied by a spectrophotometric method, and it was found that the source of the compound, the method of preparing the solutions, and the action of ultra-violet radiation upon the solutions were all significant in affecting the colour of the solutions. The decolorising effect of ultra-violet radiation on buffer solutions of the indicators showed their photochemical sensitivity. It was considered advisable that standard methods of preparing the solutions should be adopted to avoid variation. The source of the indicator was of importance and indicators for any kind of work should meet definite specifications. F. J. B.

2831. Temperature and Stability of Colloidal Solutions. S. J. Djatschkowsky. *Kolloid Zeits.* 54. *pp.* 278–284, *March,* 1931.—Reference is made to the work of Svedberg, Hardy, Pauli, Chick and Martin among others. The change of surface tension with temperature shows no linear relationship. The influence of low temperatures is a sensitive indicator for the stability of colloidal solutions. A complete coagulation cannot be attained either by high or low temperatures. A highly dispersed portion always remains in the solution. By the application of lower temperatures it is possible to fractionate a colloidal solution into its different grades of dispersion. If such a process is not applicable, a similar effect can be obtained by freezing for different time periods. J. K.

2832. Diffusion of Colloidal Particles. H. R. Bruins. *Kolloid Zeits.* 54. *pp.* 265–278, *March,* 1931.—The abnormally great diffusion velocity in hydrophilic sols is investigated. This can now be easily done by a new optical process, the principle of which is described, which permits the measurements of the diffusion constants of coloured colloids to be done in much shorter time than hitherto. It is found that the velocity is higher the easier the particular colloid "dissolves" and the more stable is the resulting sol. A new ionic effect is also described. It is shown that the diffusion velocity of hydrophilic colloids is often lowered to an extraordinary amount by the addition of small quantities of electrolytes. J. K.

2833. Formation of Alkali Metal Organosols by Molecular Ray Condensation Method. A. J. Rabinowitsch, V. A. Kargin and E. B. Fodiman. *Kolloid Zeits.* 54. *pp.* 288–295, *March*, 1931.—References are made to previous workers. An improved method for obtaining pure organosols of the alkali metals is described wherein vapours are condensed as first proposed by Roginsky and Schalnikoff. The methods of measuring the conductivity and cataphoretic velocity of these sols in vacuum are also described. The sols obtained for sodium in ethyl ether and ethylamine and for potassium in the same dispersion media and in propylamine are stable and only coagulate very slowly in the dark but more quickly in the light. Pure potassium sols are not formed in benzene, xylol and tripropylamine. The colloid gel of potassium in tripropylamine is negatively charged. The colloid particles of the sols obtained are also negatively charged and travel by cataphoresis to the anode. Purification of the sols by consecutive condensations leads at first to an increase in the cataphoretic velocity due to the removal of the surface coating of metallic oxide. The velocity then remains approximately constant. Impurities in the sol lead to a greater cataphoretic velocity and stability. Cataphoretic investigation shows the colloids to possess the following nature: ionic groups are to be found on the metallic particles, the kations of the alkali metals being in the outermost coating of the electrical double layer. This leads to the particles having a negative charge and to the stability of the sols. J. K.

2834. Thermo-Senescence Effect in Gold Sols at Elevated Temperatures, and Ageing at Room-Temperature. E. Jones and W. C. M. Lewis. *J. Phys. Chem.* 35. *pp.* 1168–1173, *April*, 1931.—Instead of the usual three to four days' dialysis, gold sol has been subjected to prolonged dialysis (up to 70 days) and examined for the thermo-senescence phenomenon [see Abstract 2303 (1929)]. This was found to be exhibited in all cases as a real and definite phenomenon, which fact renders the view that thermo-senescence may be attributed to the further removal of impurities, invalid. The conclusion already arrived at (*loc. cit.*) that thermo-senescence is due to contraction of the sol particles as a result of raising the temperature seems still to be the most probable explanation of the phenomenon. Incidentally the investigation has served to demonstrate the existence of the ordinary ageing effect at room temperature. The ageing effect decreases the stability of the sol, as shown by the increase in the coefficient β, and may well be attributed to ionic adsorptions and desorptions. The thermo-senescence effect on the other hand decreases β, *i.e.*, increases the stability of the sol. Thermo-senescence and slow ageing at ordinary temperatures are, therefore, two distinct phenomena.

H. H. Ho.

2835. Stability of an Element of Foam. D. Talmud and S. Suchowolskaja. *Zeits. f. phys. Chem.* 154. *Abt. A.* 3–4. *pp.* 277–308, *April*, 1931.—A film of substance, either insoluble or soluble, is allowed to spread on the surface of water or an electrolyte. Such substances as the fatty acids, white of egg, the alcohols and aniline are taken. A small air bubble about 1·5 mm. in diameter is allowed to rise through the film, and the time during which it remains in the surface of separation is measured. This bubble is regarded as the element of foam and the time of its existence as a measure of its stability. For films of insoluble substances on water or electrolytes which form active surfaces of separation, the stability increases abruptly to a maximum for a definite thickness of film and then gradually decreases as the thickness increases. For soluble substances, such as aniline, the maximum of stability remains constant over a much greater range, both for water and electrolytes with active surfaces of separation. For inactive electrolytes, the stability of the element of foam increases uniformly with the concentration. The effect of vapour pressure is examined. A theory of the action is given. H. M. B.

2836. X-Ray Investigation of the Coagulation Process with Colloidal Gold. P. Scherrer and H. Staub. *Zeits. f. phys. Chem.* 154. *Abt. A.* 3–4. *pp.* 309–321, *April*, 1931.—In the coagulation of a highly disperse, colloidal gold solution, the primary particles of the hydrosol first collect together irregularly to form larger secondary particles. The crystallisation of the primary particles to larger crystals may be effected by intense drying-out at the ordinary temperature or by leaving the coagulate in an electrolyte solution. The velocity of this crystallisation depends on the nature and on the pre-treatment of the sol from which the coagulate is derived, and increases appreciably with rise of temperature. Protective colloids, if added immediately after the coagulation, may prevent almost completely the aggregation of the primary particles to larger crystals by the electrolyte solution. T. H. P.

2837. X-Ray Studies of Cellulose Derivatives. Part IX. C. Trogus and K. Hess. *Zeits. f. phys. Chem.* 12. *Abt. B.* 4. *pp.* 268–278, *April*, 1931.—The fibre periodicity of trinitrocellulose is $25\cdot4_8 + 0\cdot1_4$ Å. The formation of the X-ray diagram is dependent upon the processes to which the fibre is subjected after nitration. It appears that the stabilisation is a type of recrystallisation the progress of which may be influenced by chemical operations. F. J. W.

2838. Dielectric Constant and Molecular Weight of Colloids. N. Marinesco. *Comptes Rendus*, 192. *pp.* 625–628, *March* 9, 1931.—It is possible to deduce the molecular weight of dissolved proteins by considering the dielectric properties of a dispersion as a function of the wave-length. A mathematical paper not lending itself to abstraction. [See also Abstract 2325 (1930).] J. K.

2839. Dielectric Constant and Structure of Thixotropic Sols. S. S. Kistler. *J. Phys. Chem.* 35. *pp.* 815–829, *March*, 1931.—Hypotheses of the origin of thixotropy in gels are reviewed and the assumption that hydration is at least a contributory cause is favoured. Calculation of degree of hydration from dielectric constant measurements is discussed and it is emphasised that the results obtained depend directly upon the frequency of oscillations in the measuring circuit. The influence of hydration on the dielectric constant is shown to be probably due to a direct influence on the relaxation time of the water molecules near a hydrated molecule or micelle due to their orientation and their tendency to link together. Measurements on dialysed Fe_2O_3 and Al_2O_3 sols at 32·7 cm. wave-length show little, if any, hydration but give quite definite indications of hydration in the presence of small concentrations of electrolyte. In none of the cases studied is the viscosity of the intermicellar solution measurably higher in the gel than in the sol before gelling, nor is this viscosity widely different from that of water. Thixotropy is most readily explained by the assumption that some form of orientated anisotropy of the water, probably chains of water molecules, extends out from the surface of each colloidal particle and tends to link it with the neighbouring particles. H. H. Ho.

2840. Mode of Deformation of a Single Crystal of Silver. H. J. Gough and H. L. Cox. *Inst. of Metals, J.* 45. *pp.* 71–88; *Disc.*, 89–97, 1931.—A single crystal of silver has been tested under alternating torsional stresses with the especial object of studying the formation of twin bands. Throughout the tests, however, no definite twin markings were observed, although the surface of the specimen was covered by a complete system of slip-bands in good agreement with the maximum resolved shear stress law. After the specimen had been fractured in torsional fatigue, the test portion of the specimen (containing the crack) was annealed in vacuum with the object of revealing the presence of twins. No sign of twinning was, however, observed. After the completion of the torsional test, compression specimens were machined out of the enlarged ends of the torsion specimen. These specimens were compressed by static and impulsive forces, the maximum strain imposed being about 5 per cent. Again no twin markings were observed, although in every case profuse slip on the most highly stressed octahedral planes was produced. The choice of silver as a suitable material for the study of the formation of twin bands under applied stress was made on the grounds that in the aggregate form silver is known to twin very readily. The complete failure to produce twins in the present experiments is, therefore, somewhat surprising; nevertheless this failure must be held to constitute a very important result as betraying an essential difference between the single crystal and the aggregate. [See also Abstract 3587 (1930).] AUTHORS.

2841. Influence of Metallic Coatings on the Mechanical Properties of Steel after Nitrogen Treatment. T. Yosiki. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 292. *pp.* 143–154, *March* 5, 1931. *In German.*—A 0·3 % carbon steel was treated with nitrogen at 650° C. for 1½ hours. The tensile strength increased and the elongation fell off at first and reached a constant value. The same material was coated with tin, tin-lead alloys, cadmium and cadmium alloys, and then subjected to the nitrogen treatment. The coatings prevented the nitrogen from entering the steel and the mechanical properties were not improved. The results of the investigation showed that the extremely thin layer of iron nitride which was formed by the nitrogen treatment profoundly influenced the mechanical properties of steel. F. J. B.

2842. Influence of Occluded Hydrogen on the Toughness of Electrodeposited Metals. Guichard, Clausmann, Billon and Lanthony. *Comptes Rendus*, 192. *pp.* 623–625, *March* 9, 1931.—Contrary to previous workers, the present authors show there is no relationship between the gases occluded and the toughness or strength of metals electrolytically produced. [See also following Abstract.] J. K.

2843. Influence of Occluded Gases on the Mechanical Properties of Electrodeposited Metals. L. Guillet and J. Cournot. *Comptes Rendus*, 192. *pp.* 787–789, *March* 30, 1931.—Reference is made to the results of other workers [see preceding Abstract]. In the present paper the exceedingly fine structure of metals electrolytically obtained is taken into account in explaining the small influence of occluded gases on their hardness. J. K.

2844. Diffusion of Metals in the Solid State. Part II. S. Tanaka and C. Matano. *Kyoto Coll. Sci., Mem.* 14. *pp.* 59–66, *March,* 1931.—The diffusion phenomena of various metals were studied at several temperatures by observing the change in the electrical resistance of metal foils which were made by alternate electroplating. It was concluded that the phenomena with metals which form the solid solution in all proportions not only show a similar appearance but also have nearly equal values of D which is about 10^{-9} cm.^{2}/day at 500° C. The phenomena, however, occur in a quite different manner when the component metals do not form the solid solution. [See also Abstract 1033 (1931).] AUTHORS.

2845. Molecular Constitution of the α and β Solutions of Tin in Copper Examined Thermodynamically. F. H. Jeffery. *Faraday Soc., Trans.* 27. *pp.* 136–139, *March,* 1931.—The method previously described by the author for solutions of tin in lead was used [see Abstract 2684 (1930)]. It is shown that the α solid solution consists of Cu_4Sn dissolved in copper, the molecules of copper being monatomic and that the corresponding liquid solution which occurs from 1083° to 800° C. consists of Cu_4Sn dissolved in liquid copper, the molecules of which are also monatomic. The β phase on cooling can produce a two-phase system containing the compound Cu_3Sn and also one containing the α phase which involves the compound Cu_4Sn. Evidence is given that the β solid solutions are monatomic molecules of tin dissolved in monatomic molecules of copper. C. O. B.

2846. Molecular Constitution of Solid Alloys and Liquid Solutions of the Copper-Tin Series. F. H. Jeffery. *Faraday Soc., Trans.* 27. *pp.* 188–190, *April,* 1931.—The results obtained from measurements made of temperature and change of resistance, measured on two Callendar recorders, and thermodynamic equations afford evidence on the constitution of copper-tin alloys. It is shown that the liquid phase consists of Cu_4Sn dissolved in monatomic tin molecules, the solid phase being the pure compound Cu_3Sn. It is concluded that the results given are substantially accurate to define the phase boundaries, when the data are determined by the electrical resistance method. Grave errors would make it impossible to find any thermodynamic equations to satisfy the boundary conditions. F. J. B.

2847. Quantitative X-Ray Analysis of Copper-Silver and Copper-Zinc Alloys. H. Terrey and E. G. V. Barrett. *J. Phys. Chem.* 35. *pp.* 1156–1167, *April,* 1931.—The relative intensities of the K-lines in the characteristic X-ray emission spectra of copper-silver alloys have been determined by measurement of their ionising powers. The following relationship between intensity and atomic concentration has been found to hold: $I_{Ag}/I_{Cu} = M \, . \, C_{Ag}/(C_{Ag} + C_{Cu})$. The silver radiation suffers partial absorption in the copper and gives rise thereby to secondary copper radiation, thus diminishing the silver radiation and augmenting the copper. Copper-zinc alloys have been similarly investigated and a linear relationship found between relative intensity and atomic concentration. A method for the determination of relative intensities of lines in an X-ray spectrum, dependent on the measurement of their penetration of an aluminium wedge, has been devised, and the copper-zinc alloys have been examined by this method. H. H. Ho.

2848. Solid Solutions of the Copper-Silver System. D. Stockdale. *Inst. of Metals, J.* 45. *pp.* 127–140; *Disc.,* 140–155, 1931.—The mutual solubilities of copper and silver have been determined, chiefly by the method of examining quenched specimens under the microscope. As this method fails at low temperatures, further information about the position of the phase boundaries was sought by measuring the electrical resistances of quenched wires. A "differential" method which shows up small, abrupt changes in the electrical resistances of alloys at the temperatures at which they occur is also described. The diagram obtained differs in many respects from that usually found in the text-books, but it is in close agreement with two diagrams which have been published recently in Germany. The behaviour of standard silver when it is annealed is in conformity with the constitution of the alloys as it is now described. The paper ends with a short summary of the results of other workers and a Bibliography is appended. AUTHOR.

2849. Preparation of Debye-Scherrer Diagrams of Oxidisable Alloys. E. Zintl, A. Harder and S. Neumayr. *Zeits. f. phys. Chem.* 154. *Abt. A.* 1–2. *pp.* 92–96, *April*, 1931.—Methods are developed for the production of powders of alloys which readily oxidise in air, for heat-treating the alloys and for introducing them into tubes suitable for use in X-ray examination. The alloys, such as sodium-lead alloys, are prepared in an apparatus filled with pure nitrogen and are subsequently ground to fine filings or powder in an atmosphere of nitrogen, by means of a dental drilling machine. It is found possible by these means to produce powders of materials which are very hygroscopic or very readily oxidised on exposure to air. F. J. B.

2850. Properties of Metallic Cadmium. C. H. M. Jenkins and G. D. Preston. *Inst. of Metals, J.* 45. *pp.* 307–338; *Disc.*, 339–343, 1931. —The physical properties of cadmium were investigated by means of tensile and ball hardness tests as well as by electrical conductivity measurements on "aged" and "heat-treated" material in the cast, forged and rolled conditions. The research indicates that hardness changes on rolled material which are found to occur at room-temperature are markedly affected by conditions of hot- or cold-working. By maintaining cadmium cold during rolling the material produced possesses properties markedly different from metal which is allowed to warm during this process. In the short-time tensile test, worked material is found to be stronger than cast material, but under prolonged stress the cast alloys are inferior to rolled samples. Microscopic examination was also undertaken on the various materials produced. In the cold-rolled condition the material appears to be completely recrystallised and of fine grain-size, but prolonged ageing over a period of years results in appreciable grain growth. After slight straining the microstructure of cadmium is rendered complex, and full account must be taken of the effect of the methods of preparation of the specimens for this work. The X-ray examination of samples of hot- and cold-worked cadmium does not indicate an allotropic modification at room-temperature and ordinary pressures, but there are marked differences in properties which suggest a preferred orientation. AUTHORS.

2851. Corrosion Tests of Ferrous Metals. K. Pitschner. *Am. Electrochem. Soc., Trans.* 58. *pp.* 9–21, 1930.—Methods of procedure, analysis and calculation are described which provide a definite means of evaluating the data of corrosion tests on the ferrous metals, of determining the actual protective value of coatings on these materials, and of comparing their tendencies to pit under corrosive conditions. The procedure depends on a method for determining the element iron in the metallic portion of corroded samples by means of a separation of corrosion products from metallics, with crystalline iodine. AUTHOR.

2852. Rôle of Hydrocyanic Acid Vapours in the Corrosion of Iron. J. F. G. Hicks. *J. Phys. Chem.* 35. *pp.* 893–904, *March*, 1931.—The conditions of the corrosion of iron gas mains with the formation of Prussian blue were investigated. It is found that the final product of the corrosion of iron gas mains is Prussian blue. HCN produced the maximum corrosive effect and is first in order of priority of attack. The cause of the corrosion is considered to be the solution of metallic iron in water, but HCN is the most active of the corrosive agents studied. It is shown that HCN cannot initiate corrosion in the cases studied.
F. J. B.

2853. Resistance to Corrosion of Chromium-Nickel-Iron Alloys. E. Wellmann. *Zeits. f. Elektrochem.* 37. *pp.* 142–156, *March*, 1931.—The corrosion-resisting properties of chromium-nickel-iron alloys to attack by SO_2 alone and in the presence of air and water, in H_2S, in hypochlorite, in phenols, and in tartaric and citric acids were investigated. It is found that above 400° C. the alloys become more or less liable to attack by SO_2, and that air and water increase the rate of attack. Alloys containing high percentages of chromium and iron are the most resistant to attack. Above 300° C. the alloys are not resistant to attack by H_2S. At lower temperatures the chromium exerts a retarding influence on the corrosion, as it forms no sulphide. Phenols attack only chromium-free iron-nickel alloys in water solutions. Tartaric and citric acids attack chromium-nickel-iron alloys which contain only low percentages of chromium. Alloys containing more than ⅛ mol. of chromium are resistant to corrosion by these agents. F. J. B.

2854. Protection of Iron in Aerated Saline Solutions, and the Evans Cell. E. Herzog and G. Chaudron. *Comptes Rendus*, 192. *pp.* 837–839, *April* 7, 1931.—The corrosion of iron in aerated saline solutions was shown by Evans to be due to the iron behaving as a kathode in the more highly aerated portions of the solution, and as the anode at the other portions. The realisation of such a cell was attempted by arranging a cell thus: iron aerated (NaOH)—iron not aerated ($FeCl_2$ or $FeSO_4$). The changes of potential of the combination were measured over a period of 48 hours. The e.m.f. of the cell was found to be 0·4 to 0·43 volt. The effect of various other electrolytes and of buffer solutions was also determined. F. J. B.

2855. Photosensitised Decomposition of Nitrogen Trichloride. Part I. J. G. A. Griffiths and R. G. W. Norrish. *Roy. Soc., Proc.* 130. *pp.* 591–609, *March* 3, 1931.—The induction period produced by ammonia in the photochemical combination of H_2 and Cl_2 is shown to be due to NCl_3 formed by interaction of the Cl_2 and the NH_3. The decomposition of NCl_3 in Cl_2 alone is photosensitised by Cl_2 and the net reaction is given by the equation: $2NCl_3 = N_2 + 3Cl_2$. The reaction is of strictly zero molecular order with respect to the NCl_3 until the decomposition is almost complete; then a semi-explosive reaction occurs. The velocity of the zero order reaction is directly proportional to the light flux absorbed

by the Cl_2. The quantum efficiency (γ) of the zero order reaction in homogeneous blue (436 $\mu\mu$) and ultra-violet (365 $\mu\mu$) is high (< 20) at low pressures of Cl_2 and decreases with increase of chloride pressure, $\mathrm{P}_{\mathrm{Cl}_2}$, to a limiting value in the neighbourhood of 2. The results are reproduced by the equation $\gamma = 1/0\cdot0038\mathrm{P}_{\mathrm{Cl}_2} + 2\cdot5$. No decomposition occurs in yellow (579 $\mu\mu$) or green (546 $\mu\mu$) light. The reaction is probably initiated by chlorine atoms and proceeds by way of reaction chains of short length.
H. H. Ho.

2856. Chemical Action of Ultra-Violet Light on Alkyl Iodides. G. Emschwiller. *Comptes Rendus*, 192. *pp.* 799–802, *March* 30, 1931.—Ultra-violet light liberates methane and a condensation product $(\mathrm{CH}_2)_n$ of high molecular weight from methyl iodide, ethylene and ethane from ethyl iodide (but no butane), propylene and propane from *n*- and *iso*-butyl iodides, butylenes and butanes from *n*-, *sec*- and *iso*-butyl iodides, but from *tert*-butyl iodide propylene, ethylene, propane and ethane. The quantities of saturated and unsaturated hydrocarbon are approximately equal. The reactions are explained by the equations: $\mathrm{C}_n\mathrm{H}_{2n+1}\mathrm{I}$ + light = $\mathrm{C}_n\mathrm{H}_{2n} + \mathrm{H}'\mathrm{I}'(1)$, and $\mathrm{C}_n\mathrm{H}_{2n+1}\mathrm{I} + \mathrm{H}'\mathrm{I}' = \mathrm{C}_n\mathrm{H}_{2n+2} + \mathrm{I}_2(2)$, the H′ and I′ in (1) being split off either separate or combined. One hydrogen has, therefore, apparently a function differing from that of the others. Ultra-violet light has no action on the dry vapour of an alkyl iodide in absence of oxygen; in presence thereof, together with iodine, gaseous methyl iodide yields as principal product formaldehyde, and gaseous ethyl iodide acetaldehyde, thus confirming the formation of the $\mathrm{C}_n\mathrm{H}_{2n}$ groups. Results with *n*- and *iso*-propyl iodides are more complex, but some acetone is formed from *iso*-propyl iodide. [See also Abstract **3968** (1930).] C. A. S.

2857. Periodicity and its Foundations. M. Copisarow. *Kolloid Zeits.* 54. *pp.* 257–265, *March*, 1931.—Periodic phenomena are found both in physics and chemistry. In the present work periodic phenomena are investigated which are on the border-line between chemistry and physics. The solidification of carbon dioxide, the vaporisation and condensation of ammonium carbonate, the combination of magnesium and oxygen, all show periodicity when investigated in a long tube. The reaction of magnesium oxide and yellow phosphorus or yellow phosphorus with carbon dioxide shows no signs of periodicity. The author concludes that wave-forming movements or a transition state is a general primary characteristic, independent of condition and phase. This peculiarity can be applied to the periodic system of the elements, which is itself a reflection of the relationship between energy and matter. Periodicity can be considered as a result of such wave motions. There are, however, secondary influences which, though important as these influence the actual form of the periodic reaction, are nevertheless only to be considered as disturbing factors in a general theory. J. K.

2858. Kinetics of Combination of Hydrogen and Oxygen under the Influence of Iodine. W. L. Garstang and C. N. Hinshelwood. *Roy. Soc., Proc.* 130. *pp.* 640–654, *March* 3, 1931.—The experiments are based on the observation of H. B. Dixon that iodine raises the ignition temperature of hydrogen in oxygen. The position is summarised and additional data are recorded about certain points previously studied. The surface reaction in vessels of silica and porcelain is found to be accelerated by iodine. The gas reaction occurring at relatively high temperatures and pressures is found to be retarded, and the explosion which normally occurs between certain limits of pressure to be inhibited. The amounts of iodine required are small, and the efficiency of collisions with iodine in breaking chains is found to be less than about 10^{-4}. Water vapour is found to lower the upper critical limit of the low-pressure explosion region and, in sufficient amount, to inhibit the explosion altogether. Commercial hydrogen appears to contain no inhibiting substances. The study of this influence of iodine promises to throw additional light on the nature of the reaction chains by which the change takes place. H. H. Ho.

2859. Kinetics of Reactions in Solution. Parts I and II. E. A. Moelwyn-Hughes and C. N. Hinshelwood. *Roy. Soc., Proc.* 131. *pp.* 177–198, *April,* 1931.—In Part I it is shown that the decomposition of Cl_2O in CCl_4 solution proceeds at the same rate, possesses the same temperature coefficient and apparently takes place by the same mechanism as in the gaseous state. The retardation of bimolecular reactions by solvents, which has sometimes been revealed by the comparison of the observed rates of reactions in solutions with the rates calculated theoretically, thus appears to depend on a specific influence of particular solvents, and need not occur in an " ideal " solution. Part II deals with the decomposition of trinitrobenzoic acid in various solvents, the aim being to determine whether constancy of rate and heat of activation with change of solvent can be regarded as the usual characteristic of a unimolecular reaction. Velocity constants have been determined over a temperature range of 70° C. in water, anisole, nitrobenzene, acetophenone and toluene. The heats of activation for this reaction in pure dry acetophenone, in water and in pure dry nitrobenzene are 25,000, 30,000 and 35,000 cal., respectively, a medium behaviour in direct contrast to that of nitrogen pentoxide. The rate of reaction in water is but slightly influenced by either hydrochloric acid or sodium hydroxide. The velocity of decomposition and the energy of activation are dependent on the purity of the solvent, especially with nitrobenzene. In toluene, water acts as a powerful positive catalyst, the rate of reaction being several hundred times lower than in water. H. H. Ho.

2860. Statistical Treatment of Reaction-Velocity Data. Parts I and II. L. J. Reed and E. J. Theriault. *J. Phys. Chem.* 35. *pp.* 673–689, *March, and pp.* 950–971, *April,* 1931.—A critical review of current methods of computation is given. It is shown that the usual test for unimolecularity, namely, the possibility of deriving a consistent series of k values, should be discarded. The least-squares procedures which have been described in the chemical literature are also found to be inapplicable to unimolecular data, whilst proposed systems for the weighting of unimolecular constants are inapplicable in the presence of constant errors. In Part II a statistical treatment is developed which permits of the ready derivation both of the experimental constants and of their precision values, proper allowance being made for constant errors. The discussion is limited to the unimolecular expression, $Y = L(1 - e^{-Kt})$, and the applicability of the proposed method is exemplified with reference to Pennycuick's data on the rate of inversion of sugar solutions. It is shown that these observations conform very closely to the unimolecular type of equation. The data given by Daniels and Johnston for the rate of decomposition of nitrogen peroxide are also discussed. H. H. Ho.

2861. Diagrams for Calculating Equilibria in the Reactions of Gases with Water. P. Montagne. *Comptes Rendus,* 192. *pp.* 677–679, *March* 16, 1931.—In general the system $2A \rightleftharpoons 2B + C$ is considered and particularly $CO + H_2O = CO_2 + H_2$. [See also Abstract 2003 (1929).] J. K.

2862. Heats of Formation of Hydrogen Iodide and Chlorine Monoxide. P. Günther and K. Wekua. *Zeits. f. phys. Chem.* 154. *Abt. A.* 3–4. *pp.* 193–256, *April,* 1931.—The heat tone for the reaction $2HI + Cl_2 = 2HCl + I_2$ is measured directly, the exchange being titrimetrically determined. Applying Thomsen's heat of formation of HCl, the heat of formation of HI from solid iodine is deduced as -5970 ± 50 cal. The heat of formation of Cl_2O is found to be $-25{,}100 \pm 100$ cal. by direct explosion. J. K.

2863. Diffusion Equation and the Theory of Chain Reactions. V. Bursian and V. Sorokin. *Zeits. f. phys. Chem.* 12. *Abt. B.* 4. *pp.* 247–267, *April,* 1931.—The use of the diffusion equation has made possible a mathematical treatment of the theory of chain reactions. The earlier results of Semenoff [see Abstract 2622 (1929)] on the pressure range for explosive reactions are confirmed. The cases discussed are reactions occurring in a space bounded by two parallel walls of infinite extension and in vessels which are spherical and cylindrical in shape. F. J. W.

2864. Simple Gas Reactions. H. Eyring and M. Polanyi. *Zeits. f. phys. Chem.* 12. *Abt. B.* 4. *pp.* 279–311, *April,* 1931.—The London theory [see Abstract 851 (1930)] of the reaction velocity of adiabatic transformations has been investigated for the simplest case of the double decomposition of three atoms in the rectilinear configuration $Y + XZ \rightarrow YX + Z$. The total combined energy of the separate atomic pairs in dependence upon the atomic distances has been evaluated from optical data and by aid of the Heitler-London data. The following systems have been studied: $H + H_2^{para} \rightarrow H_2^{ortho} + H$, $H + HBr \rightarrow H_2 + Br$, $H + Br_2 \rightarrow HBr + Br$. The course (dynamics) of the decomposition is worked out as a function of the potentials of the atomic distances. H. H. Ho.

2865. Activation by Charcoal. W. D. Bancroft and S. F. Whearty, Jr. *Nat. Acad. Sci., Proc.* 17. *pp.* 181–183, *April,* 1931.—It is established that purified activated charcoal causes chlorine to substitute in the ring with benzene and toluene. Custis's results are confirmed that light from an iron arc causes some ring substitution of chlorine with benzene and with toluene. Certain unspecified wave-lengths in the ultraviolet activate benzene and toluene and give rise to the ring substitution. If the action of the charcoal is not due to metallic impurities, it is concluded that charcoal must be an activating catalyst for benzene and toluene. H. H. Ho.

2866. Ignition of Dried Mixtures of Carbon Monoxide on Silica. V. E. Cosslett and W. E. Garner. *Faraday Soc., Trans.* 27. *pp.* 176–188, *April,* 1931.—Mixtures of dried carbon monoxide and oxygen were admitted into an evacuated silica vessel at 610° C. and the ignition phenomena were examined. The ignition pressures, rate of the stationary reaction, and the percentage combustion were measured. The effects of the addition of O_2, N_2, CO, A and CO_2 to the explosive mixture were studied. It was found that O_2 and A increased the ease of ignition, and that N_2, CO and CO_2 reduced the ease of ignition. A mechanism for the chain reaction in the gaseous phase is developed. F. J. B.

2867. Explosions in Closed Cylinders. Part IV. Flame Movement and Pressure Development in Methane Air Explosions. W. A. Kirkby and R. V. Wheeler. *Chem. Soc., J. pp.* 847–853, *March,* 1931.—The present paper gives the results of a study of both non-vibratory and vibratory explosions of methane and air using new apparatus which permits continuous photographic records of the movement of flame to be correlated with simultaneous records of the development of pressure. [For previous work see Abstract 1365 (1929).] J. K.

2868. Ionisation in Gaseous Explosions. W. A. Kirkby. *Chem. Soc., J. pp.* 878–885, *April,* 1931.—Reference is made to the work of Garner and Saunders on ionisation phenomena during gaseous explosions and their work is criticised. In the present work similar experiments are carried out using a more accurately recording galvanometer circuit. Direct correlation is also obtained for the progress of flame through an explosive mixture of gases with the ionisation which occurs, and evidence is obtained that after-burning is closely connected with recombination of ions formed during the primary reactions. J. K.

2869. Explosions of Mixtures of Acetylene and Electrolytic Gas. W. A. Bone, R. P. Fraser and F. Lake. *Roy. Soc., Proc.* 131. *pp.* 1–17, *April,* 1931.—Explosions of $C_2H_2 + O_2 + 2H_2$ mixtures, which have just sufficient oxygen to burn either all the acetylene to CO and H_2 or all the H_2 to steam [see Abstract 2947 (1927)], gave the thinnest and most compact flame obtained and yielded only CO and H_2, there being hence a selective burning of the hydrocarbon to these products in the flame front. This conclusion is supported by the behaviour of moist $C_2H_2 + O_2 + 2CO$ mixture, which, on explosion, gives practically nothing but CO and H_2. As the primary and only chemical change involved in the explosion flame of the $C_2H_2 + O_2 + 2H_2O$ mixture gave $2CO + 3H_2$, and as the CO as formed is probably highly excited, such CO would immediately compete with any excess of oxygen supplied and would at first probably acquire a much larger share of it than the ultimate thermal equilibrium $CO \times OH_2/CO_2 \times H_2$ ratio. Evidence of such competition is furnished by the irregularity of the flame front, by its tendency to form layers, and by the fine, highly luminous gas streams which issue from the flame front and impart a pronounced feathery appearance. This characteristic is at a maximum at about the $C_2H_2 + 1\frac{1}{2}O_2 + 3H_2$ mixture. T. H. P.

2870. Flame Temperatures of Hydrocarbon Gases. G. W. Jones, B. Lewis, J. B. Friauf and G. S. J. Perrott. *Am. Chem. Soc., J.* 53. *pp.* 869–883, *March,* 1931.—Reference is made to the work of Kurlbaum, Kurlbaum and Schulze, Fery, Henning and Tingwaldt and Griffiths and Awbery. Flame temperatures for various hydrocarbon gas-air compositions are given for methane, Pittsburgh natural gas, ethane, propane, butane, isobutane, ethylene, propylene and butylene employing the spectral line reversal method and using sodium and lithium salt sprays. The maximum flame temperatures range from 1880° C. for methane to 1975° C. for ethylene. [See also Abstract 337 (1929).] J. K.

2871. Formation of Ethylene and Acetylene from Methane in Electric Discharges. K. Peters and O. H. Wagner. *Zeits. f. phys. Chem.* 153. *Abt. A.* 3–4. *pp.* 161–186, *March,* 1931.—The maximum yields of acetylene and ethylene obtainable by the action of the electric discharge on mixtures of methane and hydrogen have been determined by varying the experimental conditions. In agreement with earlier results, the minimum expenditure for the preparation of acetylene is found to be 13 kWh per c.m. The best observed figure for ethylene was 53 kWh, in spite of the slight heat-absorption of the reaction. With these optimum energy expenditures, the concentration of acetylene (or ethylene) in the final gases is about 4·2 % (or 0·8 %), the maximum concentration obtainable being 20 % (3 %). The most suitable initial mixture consists of 2 vols. of methane and 1 vol. of hydrogen. Spectro-analytical investigations of the discharge reveal two regions, in one of which only the CH groups are visible and in the other the Swan spectrum, the Balmer series and the hydrocarbon lines. T. H. P.

2872. Nature of Triatomic Hydrogen. E. Hiedemann. *Zeits. f. phys. Chem.* 153. *Abt. A.* 3–4. *pp.* 210–240, *March,* 1931.—The condensable gas which is formed under certain circumstances by electric discharge in hydrogen, and which behaves as triatomic hydrogen, is now found to consist of silicon hydrides. The hyzone of the literature is sometimes confused with hydrogen sulphide and at other times with silicon hydrides. The following reactions of the latter products are described: reduction of WO_3 to WO_2, brown coloration with lead acetate solution, and a positive reaction with Nessler's reagent (compare similar reaction with ammonia). H. H. Ho.

2873. Decomposition of Hydrocarbons in the Positive Ray Tube. H. R. Stewart and A. R. Olsen. *Am. Chem. Soc., J.* 53. *pp.* 1236–1245, *April,* 1931.—The decomposition of paraffin hydrocarbons in the positive ray tube results from dissociation caused by impact rather than from thermal decomposition at the kathode or from secondary reactions between ions and neutral molecules. It is suggested that the propane reported by Olson and Meyers to be formed from hydrogen and ethylene may have been produced in the tube from butane. H. F. G.

2874. Effect of an Electric Field on Flames and their Propagation. B. Lewis. *Am. Chem. Soc., J.* 53. *pp.* 1304–1313, *April,* 1931.—The effects of an electric field on the flames of ten hydrocarbon-air and carbon monoxide-air mixtures have been investigated. The field was applied in the same direction as the moving gas between fine wire-gauze electrodes placed on either side of a stationary flame confined in a Pyrex glass tube. The flame was invariably pulled towards the negatively charged electrode. Photographs are included which indicate that the flame moves in the direction of positive ion flow, from which it follows that the propagation of flame is speeded up or slowed down according to the direction of the electric field and with appropriate directions and strengths the flames of all the mixtures could be extinguished. It is concluded from the data obtained that the positive ion plays an important rôle in the maintenance of flames. H. H. Ho.

2875. Electron Diffraction by 1:2-Dichloroethane. E. Bergmann and L. Engel. *Phys. Zeits.* 32. *pp.* 263–264, *March* 15, 1931.—The electron diffraction experiments of Wierl [see Abstract 3286 (1930)] with

1 : 2-dichloroethane indicate that the molecules possess a stable configuration in the unexcited state and only under special experimental conditions can partially assume a second arrangement. In opposition to the Wierl hypothesis that 1 : 2-dichloroethane is a mixture of two stereo-isomers, the authors' viewpoint is in agreement with the Debye X-ray data for 1 : 2-dichloroethane, with the dipole measurements for this product and similarly constituted compounds, and, above all, with the manifold experience of organic chemistry. H. H. Ho.

2876. Nature of the Chemical Bond. Application of Quantum Mechanics and a Theory of Paramagnetic Susceptibility to the Structure of Molecules. L. Pauling. *Am. Chem. Soc. J.* 53. *pp.* 1367–1400, *April,* 1931.—It is shown that many results of chemical significance can be obtained from quantum-mechanical equations which permit the formulation of an extensive set of rules regarding electron-pair bonds and dealing particularly with the strength of bonds in relation to the nature of the single-electron eigenfunctions involved. These rules supplement those of G. N. Lewis, and provide information regarding the relative strengths of bonds formed by different atoms, the angles between bonds, free rotation or lack of it about bond axes, the relation between the quantum numbers of bonding electrons and the number and spatial arrangements of the bonds. A complete theory of the magnetic moments of molecules and complex ions is also developed, and it is shown that for many compounds involving elements of the transition groups this theory, together with the rules for electron-pair bonds, leads to a unique assignment of electron structures as well as a definite determination of the type of bonds involved. H. H. Ho.

2877. Energy Diagram of Sodium Chloride. P. J. van Rysselberge. *J. Phys. Chem.* 35. *pp.* 1054–1060, *April,* 1931.—Recent views on chemical bonds are discussed, and a complete interaction energy diagram of sodium chloride is worked out, based on data for ionisation potential, electroaffinity, heats of dissociation in the vapour state and in solution, crystal structure, etc. [see Abstracts 842 (1928), 51, 2329, 3209 (1929), and 2348 (1930)]. Deductions from the diagram, for energy of dissociation of gaseous sodium chloride, etc., agree with experimental results. The bond in gaseous sodium chloride is probably polar. In aqueous solution there is a marked tendency to dissociate into neutral atoms, pointing to the molecule possessing a homopolar structure. C. A. S.

2878. Free Energy of Copper Compounds. M. Randall, R. F. Nielsen and G. H. West. *Indust. and Engin. Chem.* 23. *pp.* 388–400, *April,* 1931.—The paper consists of the first of an extensive review of the data of the equilibria of a metallic element. Most of the nineteen substances whose free energies are tabulated are important compounds in the metallurgy of copper. The equilibria dealt with are especially high-temperature reactions of copper, and the values given are consistent with previously published free energies, and also with the data on the non-metallic elements published by Lewis and Randall. F. J. B.

2879. Theory of the Lead Accumulator. Tarrin. *Soc. Franç. Élect., Bull.* 1. *pp.* 280–285; *Disc.,* 285–287, *March,* 1931.—An investigation was undertaken to examine the reactions which take place in the charging and discharging of the lead accumulator. The changes of weight of the positive and negative plates were determined, and the nature of the products was examined. No grounds were found for the belief that the oxide Pb_2O_5 is formed. The formation of plumbic sulphate was considered to be impossible when the laws of electrolysis and the use of the negative material were taken into account. The results of the experiments, the analysis of the active material, the change of weight of the plates, the quantity of acid used in the reactions and the heats of the reactions led to the conclusion that the theory of double sulphatation was preferable to the alternative theories. F. J. B.

2880. Theory of Electrodes. E. Newbery. *Am. Electrochem. Soc., Trans.* 58. *pp.* 187–210; *Disc.,* 210–216, 1930.—A detailed review is given of electrode behaviour, especially in relation to single potential determinations, overvoltage, transfer resistance, valve action and passivity. The normal potentials of the elements are a periodic function of the atomic number, those of the inert gases being probably zero. Transfer resistance is due solely to the ohmic resistance of a film of gas covering the electrode. It decreases rapidly with increase of the current density, owing to compression of the film by electrostatic forces between the electrode and the electrolyte; the resulting high-potential gradient causes electrons to pass readily through the film. The resistance is greatest for smooth, polished surfaces, and the effect of platinising electrodes for conductivity measurements is merely to increase the contact surface, to favour the aggregation into bubbles of the deposited gas, and to promote diffusion of the gas into the electrolyte. Overvoltage results from the high solution pressures of compounds formed between the electrodes and the liberated gas as a result of the high pressure operating, and never appears in absence of transfer resistance; it is almost independent of the current density, and is a function, not of the atomic number, but of the valency of the elements. Valve action occurs when an insoluble non-conducting compound is produced on the anode and forms a film which is permeable to hydrogen, but not to the anions present, whereas passivity results if the anodic compound is insoluble, but is a conductor of electricity. H. F. G.

2881. Temperature Measurements at Active Electrodes. Part IV. B. Bružs. *Zeits. f. phys. Chem.* 153. *Abt. A.* 3–4. *pp.* 309–319, *March,* 1931.—Temperature effects which occur at active electrodes [see Abstract 2977 (1930)] are now evaluated by means of a dynamic-calorimetric method as heat effects, and the data are employed for the determination of the absolute entropy of the mercurous ion, *viz.*, 29 ± 1 cal./deg. H. H. Ho.

2882. Phase-Boundary Potential Quartz/Solution of Electrolyte. B. v. Lengyel. *Zeits. f. phys. Chem.* 153. *Abt. A.* 5–6. *pp.* 425–442, *March,* 1931.—A new method is developed by means of which the boundary potential between quartz and solutions of electrolytes is measured. The solutions were water solutions of HCl, H_2SO_4 H_3BO_3, NaOH and halogen salts of the alkali metals. The results showed that the change of potential is conditioned by a change in concentration. The results lead to the conclusion that the potential effect is dependent upon adsorption of the electrolyte at the surface of the quartz. F. J. B.

2883. Observations at Scraped Electrodes, and their Relation to the Absolute Zero of the Potential. K. Bennewitz and Irene Bigalke. *Zeits. f. phys. Chem.* 154. *Abt. A.* 1–2. *pp.* 113–135, *April,* 1931.—The reproducibility of measurements by the scraping method has been critically examined, and a new type of apparatus developed; a metal wire is passed through a porcelain capillary, and the lower end, immersed in the appropriate solution, is scraped by means of a diamond point under a definite load. With a silver wire in silver nitrate solution the current developed reverses when the hydrogen potential of the solution reaches $+ 0\cdot605 \pm 0\cdot01$ volt. At this zero point, however, transient currents, first in one direction and then in the other, are produced on scraping the electrode, probably as a result of disturbances of the electrical double layer rather than of the production of a new interface. The influence of additions to the electrolyte and of variations of the external resistance has been studied; inert salts do not appreciably alter the reversal point. The variation with temperature of the current agrees only qualitatively with the theory of Gouy and Chapman, and indicates that at the point of reversal the interfacial potential is not zero. H. F. G.

2884. Oxidation-Reduction Potentials. Part III. Mercuric-Mercurous Electrode. S. Popoff, J. A. Riddick, V. I. Wirth and L. D. Ough. *Am. Chem. Soc., J.* 53. *pp.* 1195–1206, *April,* 1931.—The standard oxidation-reduction potential of the mercurous-mercuric electrode was determined, employing the perchlorates of mercury as electrolytes. The oxidation-reduction potential was found to be 0·9050 volt. The mean activity coefficients of perchloric acid solutions were found to be practically of the same order as those for HCl solutions up to $0\cdot4\ N$. Methods of analysis involving mercuric and mercurous salts and acidity in the presence of mercury salts are developed. F. J. B.

2885. Electrokinetic Potentials. Part VII. H. B. Bull and R. A. Gortner. *J. Phys. Chem.* 35. *pp.* 456–466, *Feb.,* 1931.—This paper deals with the temperature coefficients of the ζ-potential for the interfaces, water-cellulose, $0\cdot1 \times 10^{-3} N$. NaCl-cellulose, and ethyl alcohol-cellulose, which have been investigated between 20° and 51° C. A marked positive temperature coefficient is exhibited by the ζ-potential at an ethyl-cellulose interface. The relationship, however, is not strictly linear, the temperature coefficient varying from approximately 0·31 mV. per deg. in the range from 23·5° to 30·4° C. to 0·16 mV. in the range 44·9° to 52·1° C. The aqueous systems investigated show a much lower temperature coefficient than the ethyl alcohol-cellulose system. A maximum at about 40° C. was found for the temperature coefficient for the ζ-potential at both a water-cellulose and a $0\cdot1 \times 10^{-3} N$. NaCl-cellulose interface. For all practical purposes the temperature coefficient of aqueous systems can be ignored in streaming potential measurements made under laboratory conditions, since in small temperature ranges the temperature effect is much smaller than is the experimental error of the determination. [See also Abstract 2114 (1931) and following Abstract.] H. H. Ho.

2886. Electrokinetic Potentials. Part VIII. H. B. Bull and R. A. Gortner. *J. Phys. Chem.* 35. *pp.* 700–719; *Disc.,* 720–721, *March,* 1931.—Continues previous work [see preceding Abstract], and deals with ion antagonism. The surface potential at a cellulose-aqueous solution interface has been measured for solutions of NaCl, KCl, $CaCl_2$, $MgCl_2$, NaCl with KCl, NaCl with $CaCl_2$, NaCl with $MgCl_2$, KCl with $CaCl_2$, KCl with $MgCl_2$, and $CaCl_2$ with $MgCl_2$ up to a total kation normality of $0\cdot8 \times 10^{-3}$. With the possible exception of $CaCl_2$ and $MgCl_2$ the results obtained for the mixtures of the salts are more or less an average of the results obtained for the salts separately. There is no antagonism between $MgCl_2$ and $CaCl_2$ in a $0{\cdot}2 \times 10^{-3}$ *N* diluted physiological salt solution. There is no antagonism, as affecting the electrokinetic potential, between KCl and NaCl in the ratio of 20 : 1, or between NaCl and $CaCl_2$ in the molecular ratio of 100 : 1. H. H. Ho.

2887. E.M.F. at Moving Electrodes and the Electrokinetic Potential of Metals. S. Procopiu. *Zeits. f. phys. Chem.* 154. *Abt. A.* 3–4. *pp.* 322–331, *April,* 1931.—Movement of the electrodes of a galvanic cell produces an e.m.f. *e*, which, with pure water, is negative for Pt, Hg, Ag or Cu and positive for Ni, Pb, Al, Fe or Zn, and is equal in magnitude and sign to the electrokinetic potential found from measurements of cataphoresis. The sign of this e.m.f. is the reverse of that of the rest-potential of the same electrode. With acids, the sign and magnitude of *e* are the same as with pure water, With Cu and Zn in solutions of their salts or in solutions of potassium salts with different anions, the value of *e* varies with the concentration of the salt and shows a maximum or a minimum and sometimes change of sign. The magnitudes of the extreme and of the limiting values for high concentrations depend on the valency of the anion. Similar behaviour is shown by the electrokinetic potential, but not by the rest-potential of the metal. T. H. P.

2888. Spectroscopic Investigation of the Dissociation of Halogen Salts of Lead and Thallium in Water Solution. H. Fromherz and K. H. Lih. *Zeits. f. phys. Chem.* 153. *Abt. A.* 5–6. *pp.* 321–375, *March,* 1931.—The condition of lead and thallium halogen salts in water solution was investigated by determining the dependence of the absorption coefficient upon concentration. The extinction curves for a number of simple solutions, containing one salt in solution, and for a number of complex solutions, containing two salts, were obtained. The results showed that in solutions of lead halogen salts in water the equilibrium $Pb^{++} + R^{-} = (PbR)^{+}$ was established. The dependence of the degree of association upon the concentration was proved quantitatively. The following equilibrium constants were obtained $K\,.\,(PbCl_2) : K\,.\,(PbBr_2) : K\,.\,(PbI_2) = 2{\cdot}225 : 2{\cdot}066 : 1$. In very dilute solutions of lead and thallium halogen salts the absorption curve was a combination of the particular absorption of the hydrated metal and halogen ions. [See also following Abstract.] F. J. B.

2889. Activity Coefficients of Lead Halogen Salts and Normal Potential of Lead. H. Fromherz. *Zeits. f. phys. Chem.* 153. *Abt. A.* 5–6. *pp.* 376–390, *March,* 1931.—The association of the halogen salts to form $(PbR)^{+}$-ions in water was shown to take place by means of spectroscopic investigations. From the experimental results the "apparent" coefficient of activity was obtained, and by aid of it and the results of the spectroscopic measurements the true coefficient of activity was calculated. The equilibrium constants and the affinities were calculated for the system: $Pb^{++}_{(aq)} + R^{-}_{(aq)} = (PbR)^{+}_{(aq)}$. The solubility products for the halogen salts of lead were calculated. The normal potential for lead was found to be $E = 0{\cdot}1274$ volt for Pb/Pb^{++}. [See also preceding Abstract.] F. J. B.

2890. Electrocapillary Curve of Mercury. K. Bennewitz and K. Küchler. *Zeits. f. phys. Chem.* 153. *Abt. A.* 5–6. *pp.* 443–450, *March,* 1931.—In reply to a criticism by Frumkin and Obrutschewa [see Abstract 1378 (1929)] the authors have constructed streamless electrocapillary curves for mercury in pure solutions, whereby the earlier found maximum at + 0·5 volt has been confirmed. Additions to the solutions produce variations and an absolute null point has not been obtained. H. H. Ho.

2891. Becquerel Electrocapillary Phenomenon. J. J. Bikerman. *Zeits. f. phys. Chem.* 153. *Abt. A.* 5–6. *pp.* 451–465, *March*, 1931.—The proposed explanations given by Urbain, Donnan, Ostwald and Girard for the Becquerel phenomena are now refuted. Alternatively, the stream theory of Becquerel and Wiedemann is quantitatively developed and shown to be in agreement with experiment within allowable error. Comprehensive experimental work on various membranes and solutions is discussed. H. H. Ho.

2892. Electrometric Measurement of pH in Aqueous Solutions. A. Boutaric. *R.G.E.* 29. *pp.* 255–263, *Feb.* 14, 1931.—The various methods of measuring pH by standard electrodes, and the theory of the determinations are described. The advantages and disadvantages of the different electrodes are discussed, and the theory of the determinations is given. The paper is a compilation of methods collected from other papers to which references are given. F. J. B.

2893. Electrometric Measurement of pH and its Applications. J. Vassillière-Arlhac. *Soc. Franç. Élect., Bull.* 1. *pp.* 166–174, *Feb.*, 1931.—The measurement of pH by various methods is described, and the uses of the various types of electrodes employed in the determinations discussed. The applications of the methods to the study of electrolytic dissociation, to the determination of acidity in soils, sugars, dairy products, problems of brewing and baking are considered. The significance of pH determinations in medical biology is pointed out, and the use of such determinations for examining the effect of physical exercise, cancer and pre-cancer or anxiety are discussed. The value of the pH determinations in bacteriology is emphasised. F. J. B.

2894. Use of Tungsten Electrodes in pH Measurement and Potentiometric Titrations. H. T. S. Britton and E. N. Dodd. *Chem. Soc., J. pp.* 829–836, *April*, 1931.—The use of tungsten electrodes for the determination of pH values of alkaline solutions which contained substances which rendered the hydrogen electrode useless was experimentally studied. Tungsten electrodes were found to give satisfactory results for the potentiometric titration of certain solutions in which the hydrogen electrode was applicable, and in solutions of HCN, HN_3 and other acids in which the hydrogen electrode could not be used. The constancy of the electrodes was tested over a period of nine days. F. J. B.

2895. Measurement of Hydrogen-Ion Concentration in Unbuffered Solutions. Part II. Application of the Hydrogen Electrode. Part III. The Colorimetric Method. I. M. Kolthoff and T. Kameda. *Am. Chem. Soc., J.* 53. *pp.* 821–832, *March*, 1931.—On repeating the experiments previously described [see Abstract 1208 (1930)] in an atmosphere of nitrogen no adsorption occurs at either electrode. A platinum or gold wire electroplated with a thin coat of bright platinum, and then washed in an atmosphere of hydrogen, forms a satisfactory electrode for unbuffered solutions, acids adsorbed by an air electrode not being adsorbed by the hydrogen electrode. Such an electrode gave reproducible determinations of the pH of solutions of potassium chloride and sulphate, ammonium chloride, and zinc sulphate; it requires replating, however, after each set of measurements, being readily poisoned in unbuffered solutions. Methods of purifying several indicators, and of preparing therefrom solutions of accurately known pH are described, and also the precautions necessary in determining with an accuracy of 0·1 pH the pH of pure water and solutions of neutral salts. C. A. S.

2896. Applications of Electroosmosis to the Chemistry of Wood. K. Hashimoto. *Electrot. Laborat. Tokyo, Japan, Circ.* 76. [44 *pp.*], *Dec.*, 1930.—The structure and swelling of wood substances, the electroosmotic extraction of certain components and electro-preservation are described; and a chemical review of the constituents of wood such as cellulose, lignin, pectin, etc., is treated in detail from the colloidal standpoint. AUTHOR.

2897. Electrolytic Valve Action. Part I. Oxide Layer of Tantalum. A. Güntherschulze and H. Betz. *Zeits. f. Physik*, 68. 3–4. *pp.* 145–161, *March* 20, 1931.—Experimental results are given which necessitate the abandonment of Güntherschulze's theory of electrolytic valve action [see Abstract 1140 (1909)] that the cause of the valve action is a gas-layer in the pores of an appreciably thicker layer of oxide on the surface of the valve metal. These results show that, with tantalum, the active layer consists of a compact, non-porous layer of Ta_2O_5 and has in electrolytes exactly the same capacity as in the dry state. From a combination of optical and capacity measurements, the dielectric constant of this layer is found to be 11·1–12·0, direct determination with powdered Ta_2O_5 giving the value 11·6. This renders it possible to ascertain the true thickness of the active Ta_2O_5 layer, which, on formation up to 100 volts, amounts to 82 mμ, the strength of field in it being $12\cdot2.10^{6}$ volts per cm. During its formation it lies under an electrostatic pressure of 1300 atmospheres with small strengths of field, its specific resistance is $7\cdot5.10^{12}$ and $9\cdot8.10^{9}$ ohms/cm. respectively in the opaque and the opposite directions. Güntherschulze's earlier explanation of valve action remains valid. According to this, in the direction of flow the kathode (valve metal) contains free electrons, whereas in the other direction the kathode (electrolyte) contains no free electrons and hence requires a high voltage. T. H. P.

2898. Electrolytic Production of Cadmium Yellow. C. G. Fink and W. M. Grosvenor, Jr. *Am. Electrochem. Soc., Trans.* 58. *pp.* 475–481; *Disc.*, 481, 1930.—The advent of electrolytic cadmium as a byproduct of electrolytic zinc has aroused renewed interest in the metal and its products. Cadmium yellow is one of the best yellow pigments available. It is brilliant and very permanent. Present methods of manufacturing the colour are not satisfactory. An electrolytic method was developed which suggests commercial possibilities. Ferrous sulphide serves as the source of sulphur. The anolyte is a 0·06 *N* solution of H_2S at 25° C. The katholyte is a weakly acid solution of FeS or other sulphide. A two-compartment cell is used, the voltage ranging between 0·2 and 0·5. A finely divided iron powder is produced as a byproduct. AUTHORS.